aw-Hill Publishing Company, Inc. October, 1927 Thirty-five Cents per Copy

CHEMICAL & METALLURGICAL ENGINEERING

Volume 34 Number 10

CHEMICAL & METALLURGICAL ENGINEERING

H. C. PARMELEE, Editor

Chemical & Metallurgical Engineering is the successor to *Metallurgical & Chemical Engineering*, which, in turn, was a consolidation of *Electrochemical & Metallurgical Industry* and *Iron & Steel Magazine*. The magazine was originally founded as *Electrochemical Industry*.

Contents, October, 1927

McGRAW-HILL PUBLISHING COMPANY, INC., Tenth Avenue at 36th Street, NEW YORK, N. Y.

New York District Office, 285 Madison Avenue
Cable Address: "Machinist, N. Y."

Number of Copies Printed This Issue, 12,200

The annual subscription rate is $3 in the United States, Canada, Mexico, Alaska, Hawaii, the Philippines, Porto Rico, Canal Zone, Cuba, Honduras, Nicaragua, Dominican Republic, Salvador, Peru, Colombia, Bolivia, Ecuador, Argentina, Panama, Brazil, Uruguay, Costa Rica, Guatemala, Paraguay, Chile, Haiti and Spain. Extra foreign postage in other countries $2 (total, $5, or 21 shillings). Single copy 35c. Change of address—When change of address is ordered the *new* and the *old* address must be given. Notice must be received at least ten days before change takes place.

Published monthly. Entered as second-class matter July 13, 1918, at the Post Office at New York, N. Y., under the act of March 3, 1879. Printed in U. S. A.

Searchlight Section, 204-210; Professional Directory, 202-203; Ready Reference, 216-218-220-222; Alphabetical Index, 224

The "handle end"

is important

ASK a cutter why he likes the Oxweld cutting blowpipe. One thing he always mentions is the oxygen valve. It works easily (it works *with* the gas pressure, not against it) and is easy to replace.

Any valve in constant use will wear out and need adjustment. Every mechanic knows that. So the Oxweld cutting blowpipes are all designed with a standard valve mechanism. The valve is as easy to replace as an automobile tire valve—one nut to unscrew and the valve can be slid out, adjusted or replaced.

It is but one of the indications that Oxweld equipment is practical, designed by men who know welding and cutting and build it for service.

That's why Oxweld is ahead of the field.

Oxweld

WELDING AND CUTTING APPARATUS

OXWELD ACETYLENE COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

CHICAGO 3642 Jasper Pl.	LONG ISLAND CITY, N. Y. Thompson Ave. and Orton St.	SAN FRANCISCO 8th nd Brannon Sts.

STOCKS IN 39 CITIES

McGraw-Hill
Publishing Company, Inc.
James H. McGraw, President
E. J. Mehren, Vice-President

CHEMICAL & METALLURGICAL ENGINEERING

H. C. Parmelee
Editor

Volume 34 New York, October, 1927 Number 10

Lessons from The Chemical Exposition

EXPOSITION week at Grand Central Palace in New York has come and gone, and one of the most successful and satisfying expositions of chemical industries has passed into history. To those who had not the good fortune to attend there is no adequate means of portraying the exhibits or conveying the spirit of an institution that has become established as a promotional factor in American chemical industry. Alphabetical lists of exhibitors and their products, photographs of booths, reports of meetings and all the time-worn devices of news reporting would be not only dry reading but hopelessly inadequate means of intelligently informing the absentees.

THE plan of admission by invitation adopted this year proved highly satisfactory. Admission cards were readily obtainable from exhibitors by interested persons who, on registration, obtained passes good for the week. There was no general paid admission, but 16,000 registrants furnished ample testimony of the practical utility of the exposition to the rapidly growing chemical industries of the country. At no time were the floors crowded with curiosity seekers and catalog collectors, but exhibitors found ample opportunity to discuss problems with visitors and go into satisfying details of construction and use. There was time for leisurely inspection and study.

EXHIBITORS again expressed a majority preference for a biennial show, and the management announced that the next exposition would be held in the spring of 1929. There was a substantial minority in favor of annual shows; but from the visitor's point of view the impression was gained that a two-year interval is more likely to insure the display of new equipment and products, and thus lend an element of novelty that is likely to be lacking in annual exhibits. Hence, ignoring the fact that momentum is undoubtedly lost in a two-year interval, it seems likely that the biennial plan meets the approval of most of those concerned.

CHEMICAL manufacturers *per se* were again poorly represented in numbers. From *Chem. & Met.'s* point of view this is a weakness of the exposition that only the chemical manufacturers can remedy. Those that were represented made conspicuously good exhibits and attracted more than their share of the visitors. In fact, if visitor interest be taken as a criterion, the chemical manufacturers who exhibited were justified in their policy. *Chem. & Met.* still believes, as previously expressed, that equipment is only half the story, and that materials hold an equal interest for the visitor. In passing it may be remarked that the Government was an instructive and intelligent exhibitor.

THE international aspect of the exposition was not as apparent as might have been expected. Whether this was due to apathy on the part of foreign manufacturers and a feeling of inability to compete with domestic producers, or to a lack of promotion abroad cannot be stated. In any event the lowering of the bars to foreign exhibitors produced no disquieting results. American manufacturers, on the other hand, gave evidence of progress during the past two years and exhibited some new equipment and materials. These will be reported in the Equipment News columns of *Chem. & Met.* beginning with this issue for the benefit of those who could not personally visit the exposition.

Market Appraisal of Chemical Industry

RESEARCH is not listed as such on the New York Stock Exchange but some of its results have recently meant millions to the stockholders of leading chemical companies. The results of an inquiry on "What Chemists are Worth?" were recently published by the Boston News Bureau in an article that has attracted wide attention in financial circles. It is pointed out, among other things, that while most stocks such as motors and the oils are actually lower than at the high point of February, 1926, the chemical stocks as a group are approximately 83 per cent higher than eighteen months ago.

Of the nine stocks listed on the New York Exchange which this article classes as "chemical," only one is selling lower today than at its high point in February, 1926. The chemical stocks are: Air Reduction, Allied Chemical, Commercial Solvents, Davison, duPont, Mathieson Alkali, National Distillers, Union Carbide and U. S. Industrial Alcohol. These nine chemical stocks averaged 105.81 on February 11, 1926, and 193.98 on August, 2, 1927—an increase of 83.1 per cent. During this same period the Dow-Jones industrial average increased from 162.31 to 185.55 or but 14.3 per cent. After briefly reviewing the new processes and products which the research laboratories of each of these companies have contributed in recent years, the article concludes that herein lies the difference between chemical stocks and the ordinary run of industrials.

It is true, as Arthur D. Little has recently pointed out, that in no field of investment do the securities of new corporations require such close technical scrutiny as where the enterprise is based on chemical processes. It is also true, that there is no other field in which an investment in industrial research may be expected to yield such handsome returns.

A Clash of Tariff Systems

SELDOM, if ever has the United States become involved in a more hopeless tariff controversy than that which is now disturbing our relations with France. Basic political principles are at stake and the task of reconciling two entirely different tariff systems overshadows, at the moment, any possible commercial advantage to either country.

France holds that her economic interests are best served by a tariff that leaves a certain margin for international bargaining. Our traditional policy, on the other hand, is to give equal treatment to the trade of all nations. There is, however, the single exception that section 317 of the present tariff law gave the president, for the first time, the retaliatory power to impose additional duties (or even to declare an embargo) on the goods from any country that discriminates against our commerce. To date, this authority has never been exercised and, in spite of the fact that France is the only country that practices discrimination against the United States, our government is very reluctant to increase the duties on French materials.

The French tariff reform of August 30, 1927, increased, in some instances by 400 per cent, the duty on American imports, at the same time extending extremely favorable concessions to Germany. In answer to our protest the French government has expressed its willingness to negotiate only if we can guarantee "such reductions or adaptations of the tariff as might appear necessary to permit the sale of certain specific French goods on the American market." To grant such a precedent to France might well be the starting point for damaging tariff wars such as the Geneva Conference so specifically warned against.

Fortunately as far as chemicals are concerned the United States is not likely to be seriously handicapped, no matter what turn the present situation may take. Sulphur, our principal chemical export to France, and potash, our principal import, are both on the free list and therefore not affected. Practically all of the fine chemicals, perfumes and perfumery materials now imported from France can either be produced in this country or obtained elsewhere from abroad. The total value of our chemical imports from France is about $15,000,000 as compared with only about $5,000,000 worth of chemicals which France purchases from the United States.

In spite of the fact that an embargo might result in a temporary gain for the American chemical industry, it is to be hoped that some more satisfactory settlement of the Franco-American tariff controversy may be reached in the very near future. Only in this way can we avoid the international bitternesses and the serious economic consequences that follow tariff wars and trade antagonisms.

A Giant Industry of the Future

THAT THE UNITED STATES of America will within a few years have a fixed nitrogen industry of respectable proportions is indicated by recent technical and economic trends both here and abroad.

As far back as 1898 Sir William Crookes predicted that the fixation of atmospheric nitrogen would some day be an important industry, this prediction being based more on the probable demand of future populations for foodstuffs rather than on any substantial contemporary progress in the chemistry of nitrogen. Since 1898 such progress has been recorded that there remains no reasonable doubt as to the ultimate position of nitrogen fixation in the general industrial structure. Col. G. P. Pollitt of Synthetic Ammonia and Nitrates, Ltd., aptly summed up the situation with the words: ". . . the nitrogen industry must inevitably develop to a point where it must become one of the most important manufactures, such as coal, steel, shipbuilding, etc."

Thus far, measured solely by actual commercial output, America has contributed but little to the present world consumption of 1,250,000 annual tons of fixed nitrogen. Germany and Great Britain hold the leading positions and their production now greatly exceeds the combined output from natural and byproduct sources.

This country is, however, rapidly approaching the time when accumulated results of fundamental research can be capitalized with reasonable assurance that commercial success will follow. It is no secret that the two largest chemical enterprises in the United States are intensively promoting broad research programs in nitrogen fixation and from these we may naturally expect eventual growth to large commercial units.

Not the least interesting aspect of the infant fixed nitrogen industry is the coincident development that already is manifest in some degree. That is, the producer of synthetic ammonia must of necessity develop a technique that is applicable to other catalytic gas reactions. Hence it is likely that the domestic fixed nitrogen industry when once firmly established will be interlocked both technically and economically with an organic chemical industry of broad scope on the one hand, and with the inorganic chemical fertilizer industry on the other.

Safety Measures Aid in Productivity

A SAFE FACTORY is an efficient one. This apparently is a proper conclusion from the elaborate study of the relation of safety to productivity which has been completed by the American Engineering Council. Elsewhere in this issue J. E. Hannum, who directed these investigations, has summarized for *Chem. & Met.* the studies of several of the chemical engineering industries investigated. The results clearly demonstrate that there is a responsibility upon management for safety measures. But fortunately the results are equally convincing in their demonstration that safety measures will aid in plant productivity and presumably, therefore, will become aids toward dividends.

This demonstration was emphasized and reinforced by conclusions to be drawn from the excellent papers given before the Chemical Section of the National Safety Council at the recent Safety Congress in Chicago. It should remove the last vestige of support for the old-time management which has been unwilling to undertake means for protecting its employees because, as was said, "It doesn't pay." Such managements are grossly in error and sadly out of date. Safety pays a tremendous dividend in satisfaction to management as well as in productivity and dollars to owners.

Permanent Endowment for Industrial Research

AN INDUSTRY that has not always been a leader in scientific research and its chemical engineering application has just announced a program that may well portend a new era in organized industrial research. Plans for the raising of a million-dollar fund for the permanent endowment of leather research by the tanning industry are outlined in the news pages of this issue. If these plans can be successfully consummated the leather industry will have placed industrial research in at least one field entirely beyond the fortunes and misfortunes of its trade association.

The significance of this move can well be appreciated by those who have found it necessary to "sell and re-sell" the industries each year on the value of organized research. Progress will, perhaps, be less spectacular under such conditions but certainly it should be more substantial and of greater usefulness. The Tanners' Council is to be congratulated in its pioneering endeavor and *Chem. & Met.* heartily commends the endowment program to the industry that is to profit from it.

Agricultural Forecasts and Chemical Engineering Industry

SINCE THE PRODUCTS of agriculture have become the raw materials for many new chemical engineering industries, chemical engineers have exhibited an enhanced interest in the forecasts of the Department of Agriculture as to expected crops. While these forecasts are undoubtedly of interest, we would caution against letting them influence plans for future business, especially in the chemical engineering field.

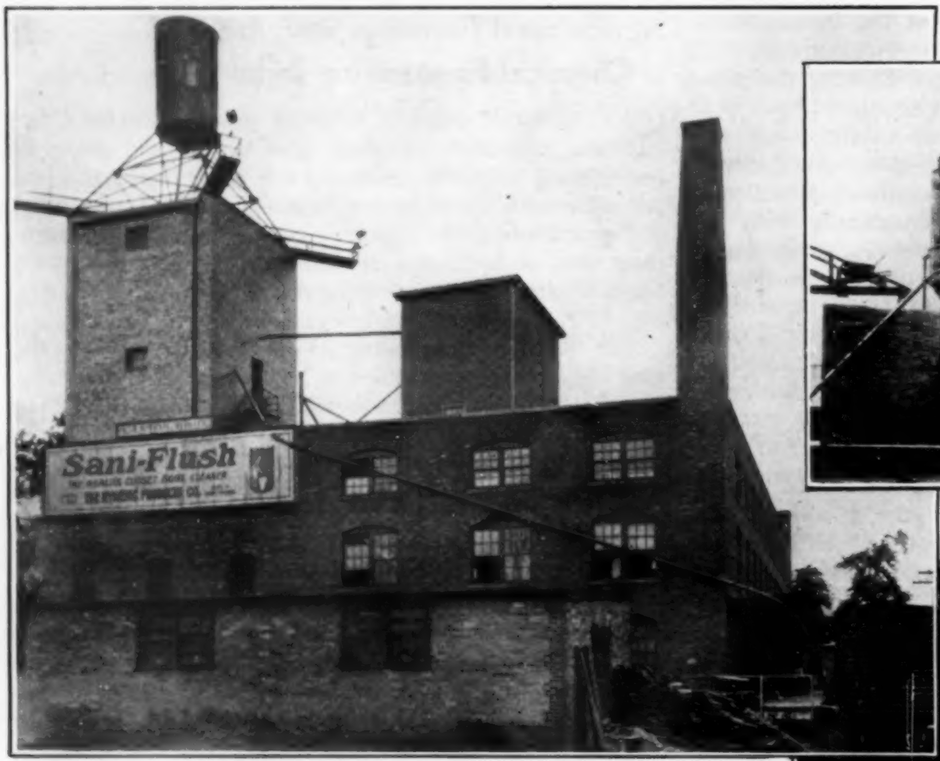
The point of the matter is this: In most cases the user of an agricultural product as a chemical raw material is in a preferred position. He can afford to pay more for his supply of the material than other users can. Hence, no matter how small the crop may be, within the bounds of any reasonable expectation, he can rest serene. A rise in prices that might seriously handicap the textile manufacturer or ruin the producer of beef or pork, will have but little ultimate effect on his business. Close attention to the market will enable him to buy his supplies at the best current prices. The spread between his raw material cost and his selling price should then be adjusted in such a way as to insure the manufacturer of a reasonable profit.

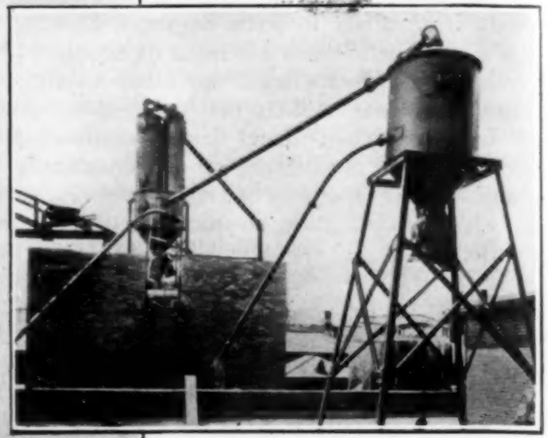
For the Good of the Service

AN ENCAMPMENT school in the vicinity of New York was attended this summer by one of our engineering friends who qualifies as a reserve officer in the Chemical Warfare Service. Some of his observations were of interest to us and might well be aired for the good of the service. He not only noted chemical ignorance in military quarters but also considerable military ignorance in chemical quarters.

Certain routine maneuvers at the camp included a cavalry charge from behind a smoke screen. Some of the staff officers present at these maneuvers were greatly surprised at the effectiveness and neatness and complete success of this surprise movement made possible by the smoke screen. No officer familiar with the tactical uses of smoke as demonstrated in the World War, and many times since, should have been surprised by such results. If our higher army officers are to be judged by this instance, it would seem that considerable educational work is still to be done by the Chemical Warfare Service. Like charity, it should begin at home and it would seem that the actual practice of chemical warfare should form a more important part in the training of officers for all of the different branches of service.

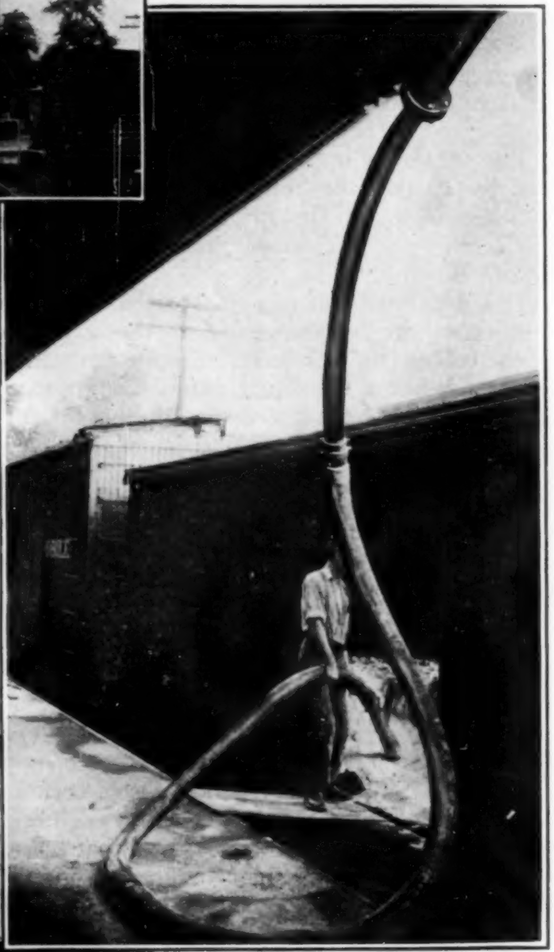
It is also an unfortunate fact, according to our friend's observation, that very few chemists and engineers who are familiar with the chemical properties of chemical warfare agents know anything at all about tactical maneuver. It is difficult for chemical warfare officers to acquire this knowledge. The appropriations are so limited that less than one per cent of the chemical warfare reserve officers in a given corps area have the opportunity for such instructions. This is a situation that might well have the organized attention of those interested in making the chemical warfare reserve an efficient and effective arm of the service.

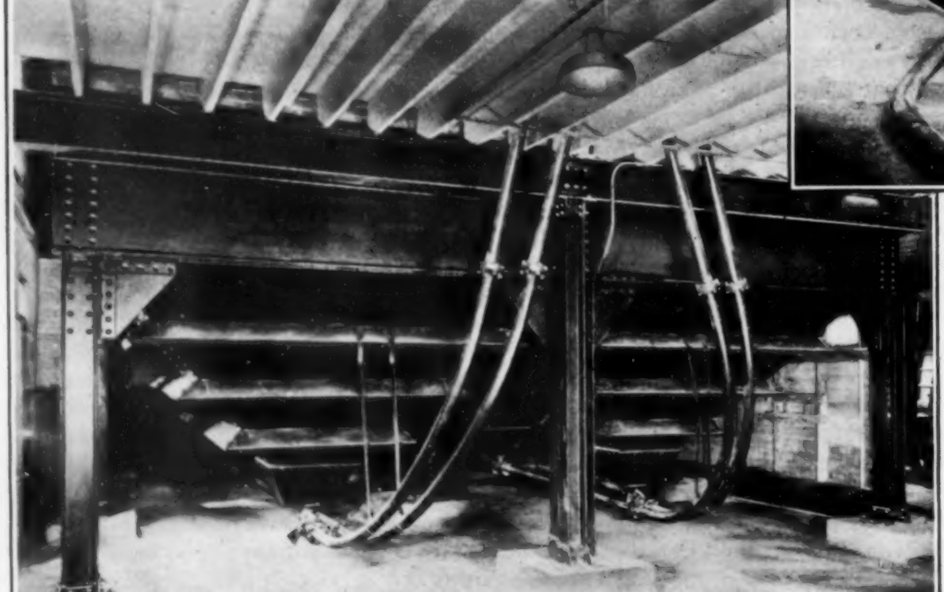




Pneumatic Conveyors Help to Solve a Raw Material Handling Problem

When production schedules called for doubling the plant capacity on "Sani-Flush," the Hygienic Products Company, Canton, Ohio, met the problem by the use of a pneumatic conveying system for handling their powdered raw materials, together with the installation of continuous, automatic machinery for processing, finishing and packing the product. Not only was this plant able to double capacity without additional floor space, but there was room available after the changes for the manufacture of another product.





A general view of the plant after the completion of the pneumatic conveying installation is shown in Fig. 1 at the upper left. Fig. 2—Upper right, shows the conveyor receivers before housing. The illustration above, Fig. 3, shows the unloading process in operation. The bottoms of two of the four storage bins are shown in Fig. 4 at the left.

Modernization of Equipment Doubles Manufacturing Capacity

By L. M. Schlabach
General Manager, Hygienic Products Company, Canton, Ohio

SOMEWHAT over a year ago we found ourselves faced with the problem of doubling capacity in our Sani-Flush plant, with no available floor space. After careful study of the problem by officials of our company and outside engineers it was decided that the best plan was to get away from the methods then in use and replace old equipment with the best of modern machines. It was found that our capacity could be doubled and a saving in reduced cost of labor, together with a saving in cost of raw material when purchased in bulk, could be effected that made it an economic necessity to turn from our old method to one of continuous operation, involving pneumatic conveying, continuous mixing, pneumatic filling and weighing, and automatic labeling and packing of the finished product. As the new plant was laid out practically around the conveying system, this feature would seem of most interest.

THE first step in the readjustment of the process of manufacture was the installation of a pneumatic conveying system for the handling of raw materials, salt and sodium bisulphate. The system is designed to take care of all the problems of conveying raw materials; the unloading of cars as well as conveying to storage bins, and reclaiming from storage to service bins. This system simplified the rest of the problems, as these consisted mainly of simple mixing, packing and shipping operations. We, therefore, feel that a complete description of the pneumatic conveying system, together with the results obtained, will be of interest.

The photographs on the opposite page show a number of features of the plant after the conveyor installation was made. Note the pneumatic conveying pipe on the side of the building. A view of the pneumatic receiving stations before housing in, is shown also, together with views of the conveyor in action and the suction pipes connecting to two storage bins.

Fig. 5 shows the general outline of the system, which consists of a high vacuum pump, two collecting stations and necessary pipelines, intake hoppers and nozzles. One of these stations is equipped with filters to assure the collecting of all conveyed fine materials. The main collecting station, as shown in Fig. 2, is placed above the storage silos in such a way that raw material may be drawn from the car at unloading dock and put into either of four silos. This station is equipped with dust filters which make certain a complete separation of the conveying air and the intrained material. From the receiver of this station a 3-in. line runs to the unloading dock. Fig. 5 also shows a plain receiver placed on the roof of the main plant directly above the service bins which supply the mixers. When required at service bins, the material is drawn from bottom of storage silos to the plain receiver and discharged to either of three service bins. The air line runs to the station above the silos where any fines in conveying air are filtered out and returned to the silos. This arrangement requires the use of only one pump and one set of filters.

The raw material is wanted at the mixers on the third floor of the plant some distance from the tracks, and, before installing the pneumatic unloading system, it was necessary to barrel the bulk cars to facilitate handling from cars to storage and from storage to service bins at mixers. This made the unloading of a car, especially of bulk sodium bisulphate, both a mean job and one that required a large crew of men. The work of barreling and trucking a car to storage usually required a crew of ten men for about five hours, while even more time was required to reclaim the same carload from storage and deliver it to service bins at the mixers.

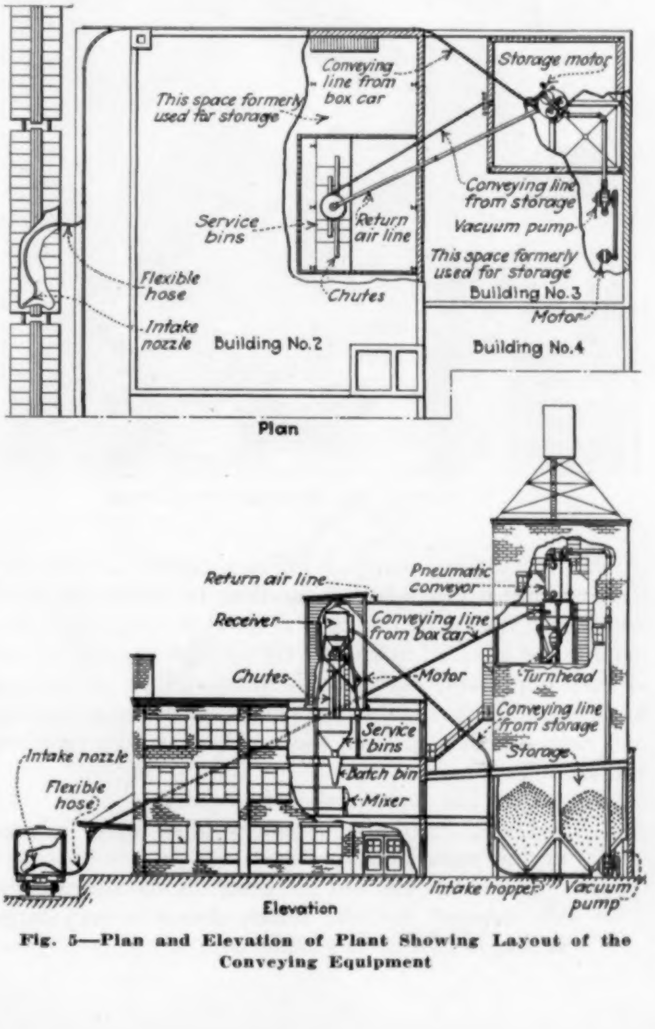


Fig. 5—Plan and Elevation of Plant Showing Layout of the Conveying Equipment

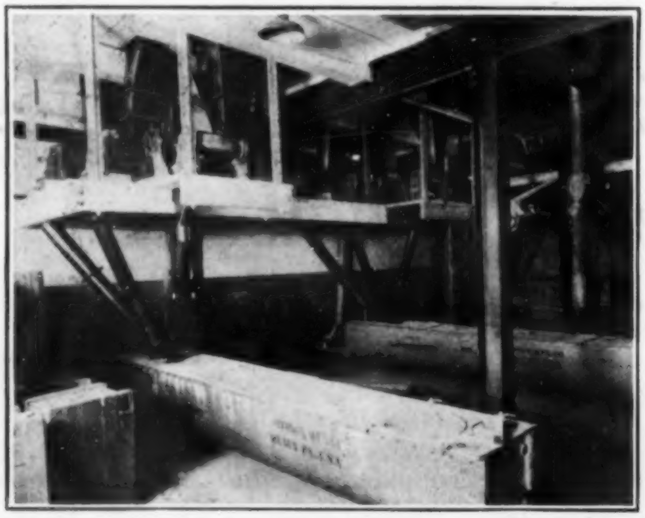


Fig. 6—Installation of Continuous Mixers and Feeders

With the pneumatic conveying system, one man is able to unload the car and convey it to storage in the same length of time that was previously required when ten men were employed on the job. The work of reclaiming from storage to service bins shows about the same saving in labor.

The system is of the high vacuum type. A 50-hp. motor operates the equipment and the capacity is 11 tons per hour over the shortest pull (100 ft.) and 8 tons per hour over the longest distance (225 ft.).

Only a small diameter pipeline is required; the lines in this installation being 3 in. in diameter at the car, thus making it possible for one man to handle the hose and intake nozzle at the car. The high vacuum system handles the material in an entirely dustless manner, which is very important, especially in the handling of sodium bisulphate. It thus makes the plant cleaner, more healthy and safe, and has reduced the number of men required and labor turn-over.

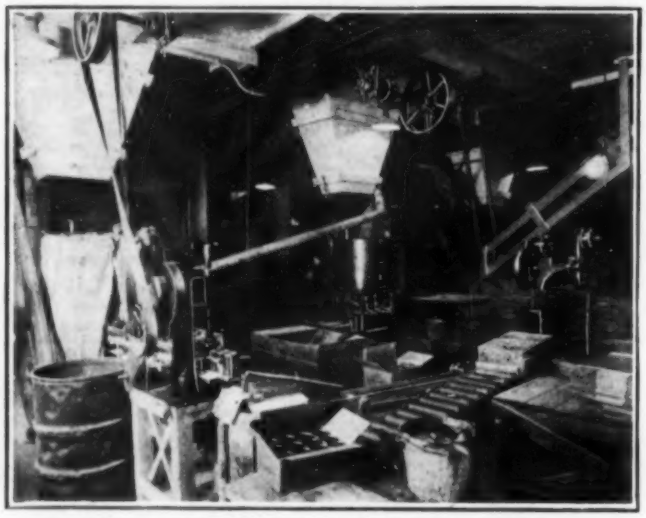


Fig. 7—Packing the Finished "Sani-Flush"

The system has accomplished four things:

1.—Reduced the necessary labor used in conveying material 90 per cent.

2.—It has enabled the company to contract for all material in bulk, which shows a very large saving in cost of raw material.

3.—It has freed a large part of the floor space in the plant for manufacturing purposes which has been used for storage. This was accomplished by constructing silos outside of the main plant, which are used for storage.

4.—It enables raw material to be conveyed from storage to service bins only twice daily, thus permitting one man to take care of all the work of unloading cars and conveying material both from the cars to storage and from storage to service bins.

This system shows a saving in cost of raw material and labor of approximately $35,000 per year, which will repay the total expense of erecting silos for storage purposes and the purchase of the conveying system, in a period ot approximately eighteen months. The conveying system was installed by the Dust Recovering & Conveying Company, Cleveland, Ohio.

Fig. 8—Labelling and Casing the Product Packed as Shown in Fig. 7

The next step was the installation of three continuous mixing machines; the raw material passing from service bins on the third floor, shown in Fig. 3, through automatic feeders to these mixers on the second floor. The continuous mixers and feeders, shown in Fig. 6, were furnished by the Robinson Manufacturing Company, Muncy, Pa.

The finished product is dicharged from the continuous mixers to the filling machines on the first floor of the plant. Here the cans are filled and weighed pneumatically before passing to the capping machines. The filling and weighing machines, shown in Fig. 7, were furnished by the Pneumatic Scale Company, Norfolk Downs, Mass. The cans then pass to the labeling and casing machines, shown in Fig. 8, which finish the operation and discharge the finished product to the shipping room, through an automatic sealing machine.

The installation of this highly efficient process of conveying, manufacturing and handling of our product from start to finish, has enabled this company to meet an ever increasing demand without additional floor space. Not only this, but there remains the further fact, without which this description would not be complete, that besides doubling the capacity of the plant, these changes have made available sufficient space to permit us to manufacture still another product, a water softening compound.

A Graphical Method of Determining Heat Transfer in Pipes

By *William H. McAdams*

Professor of Chemical Engineering, Massachusetts Institute of Technology

THE PURPOSE of this paper is to emphasize the advantages of a method of plotting overall coefficients of heat transfer from fluid to fluid, as in surface condensers, tubular apparatus heating a fluid by condensing vapors, and tubular apparatus for exchanging heat from fluid to fluid. The advantages over the graphical methods commonly used, are: (1) The method is sound. (2) The test data are easily plotted to give a linear relationship, well suited for interpolation or extrapolation. (3) The overall coefficient is resolved into its component parts, thereby making the data of more general applicability than before applying the method.

It has long been known that the overall resistance to heat transfer, $R = 1/U$, is equal to the sum of all the individual resistances through which the heat flows in series. The method will be illustrated by considering the case of a surface condenser, with steam condensing outside the tubes, and cooling water flowing in turbulent motion inside the tubes, i.e., at a velocity above the critical value. Under these conditions laboratory tests show that the individual resistance on the water side, $r_w, = \frac{1}{bv^{0.8}},$ where v is the average water velocity in feet per second, and b is an empirical constant depending on the dimensions of the apparatus, and temperature. The resistance concept then may be written:

$$\frac{1}{U} = (r_v + r_t + r_s) + \frac{(1)}{bv^{0.8}}, \qquad (1)$$

where r_v, r_t and r_s represent, respectively, the individual thermal resistances from vapor to metal, that of the tube wall, and that of any scale, slime, rust or other deposit on the tube. For convenience, all resistances are expressed per square foot of condensing surface.

In a series of tests, at different water velocities, it is found that the major fraction of the total thermal resistance is on the water side. Hence the terms in the parenthesis of equation 1 remain substantially constant, and a plot on rectangular co-ordinate paper of $1/U$ as ordinates versus $1/v^{0.8}$ gives a substantially straight line. The intercept of this line is $r_v + r_t + r_s$, and the slope is $1/b$. This method was suggested by E. E. Wilson in 1915 (*Trans. A.S.M.E.*, vol. 37, page 47), but was not generally appreciated or adopted at that time.

The lower curve of Fig. 1 shows such a plot of data for a clean condenser tube, based on the data of Orrok (*Trans. A.S.M.E.*, vol. 32 (1910) page 1773). The outside diameter of the tube was 1.00 in. while the inside diameter was 0.902 in. The excellent linear relationship justifies the method and makes extrapolation reliable and easy. To simplify matters further, one could add two additional sets of co-ordinates to Fig. 1: values of U, as ordinates in the right-hand side, running *downward*, and values of v, as abscissæ running from right to left along the top margin. One could then plot the test values of U and v directly on these two additional scales, making it unnecessary to calculate the reciprocals $1/U$ and $1/v^{0.8}$.

The units here employed for U are B.t.u. per hour per square foot of condensing surface per deg. F. mean difference in temperature between steam and water. The intercept of the lower curve of Fig. 1 shows that $r_v + r_t + r_s$ is 0.00040, and r_s is zero for the clean tube. The tube wall was made of Muntz metal, having a thermal conductivity of 63 per foot of thickness, and since the tube thickness was 0.00408 ft., r_t equals 0.000068. Hence, by difference, r_v equals 0.000332, which is equivalent to a steam-side coefficient of 3,010. The slope is $0.00373 = 1/b$, hence b equals 268, which is the water-side coefficient for a water velocity of one foot per second. The correct empirical equation for the new tube is therefore:

$$\frac{1}{U} = 0.00040 + \frac{1}{268v^{0.8}} \qquad (2)$$

Fig. 1 also shows the results for an old tube having a deposit of scale or rust; conditions otherwise being the same as for the new tube. One would therefore

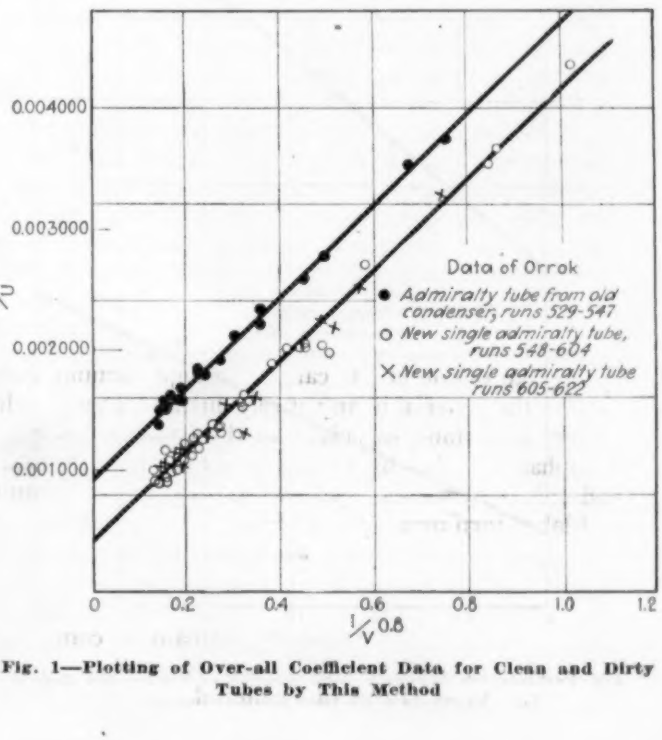


Fig. 1—Plotting of Over-all Coefficient Data for Clean and Dirty Tubes by This Method

expect a higher line for the old tube than the new, and the two should be parallel. Such is found to be the case, and the equation for the old tube is as follows:

$$\frac{1}{U} = 0.00092 + \frac{1}{268v^{0.8}} \qquad (3)$$

The difference in intercepts, 0.00052, represents the thermal resistance of the deposit, and hence the coefficient for the scale is 1/0.00052 or 1,920.

At the two extreme water velocities used by Orrok, the ratios of the overall coefficient for the dirty tube to that for the clean tube are 0.715 and 0.875. This ratio, or "cleanliness factor," varies with the water velocity, and to employ a constant cleanliness factor at various water velocities is unsound, yet is common practice today. The actual scale resistance was independent of water velocity in these tests, and would vary only with conditions governing the rate of growth of the deposit. This point brings out another advantage of the resistance concept. It is thus seen that the simple plot of Fig. 1 yielded considerable information not ordinarily obtained from test data of this kind.

Fig. 2 shows the data of Bray and Sayler (*M.I.T. Chem. Eng. Thesis,* 1923) for the separate condensation of steam and benzol vapor in a single-tube condenser. A comparison of the intercepts for the two fluids shows that condensing benzol vapor gives a resistance on the vapor side much higher than that obtained for steam.

Incidentally, one can compare the value of *b* for large-scale apparatus, obtained from *U* by the graphical method here illustrated, (Fig. 1) with the value of the water-side coefficient determined in the laboratory by direct measurement with thermocouples attached to the tube. This has been done by McAdams, Sherwood, and Turner (*Trans. A.S.M.E.,* vol. 48 (1926), page 2033) and satisfactory checks were obtained. Such a comparison lends confidence to the application of laboratory data on single-tube condensers to plant practice involving many tubes in parallel.

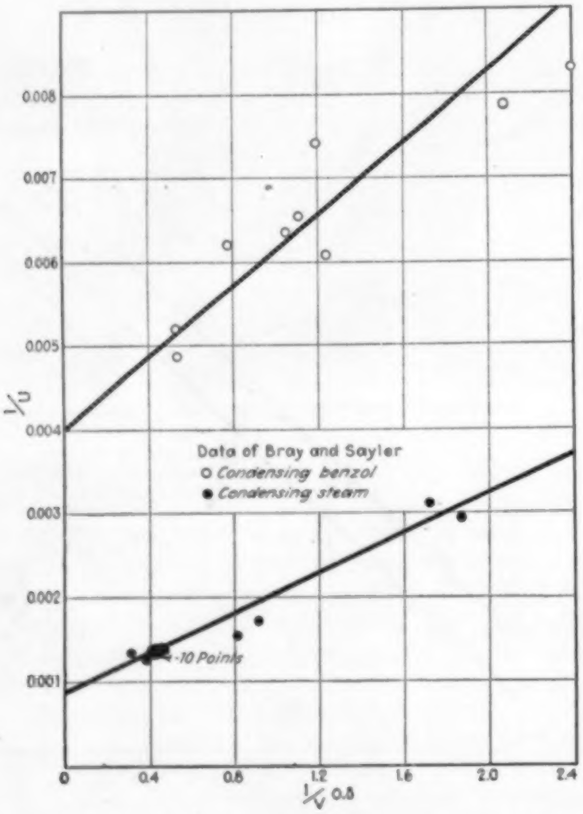


Fig. 2—Data for Separate Condensation of Steam and Benzol Vapor in a Single-Tube Condenser

Obviously there are a number of other applications for this graphical method of analysis. For example, it could be applied to tests on oil-to-oil heat exchangers, such as are so widely used in the petroleum industry, and in light-oil absorption plants. In the application to surface condensers the overall resistance depended primarily on the water velocity. In other cases, other variables may have to be taken into account, such as viscosity and diameter. However, a quantitative knowledge of the factors affecting the individual coefficients involved, and the relative order of magnitude of the different resistances in series, will determine what group of factors should be used as abscissæ in plotting the observed values of $1/U$. Haslam, Ryan, and Weber (*Ind. Eng. Chem.,* vol. 15, No. 11 (1923), page 1105) have plotted overall coefficients of absorption by a method analogous to that used in Fig. 1.

Automotive Fuels Hold Chemical Interest

IF THE sulphur content of gasoline could be 0.3 per cent instead of 0.1 per cent the saving to the petroleum industry would be $50,000,000 per year. This estimate of the economic significance of sulphur in gasoline developed during the discussion of two papers by H. C. Mougey of the General Motors Research Corporation and S. H. Diggs of the Standard Oil Company of Indiana before the Petroleum Division of the American Chemical Society at the recent meeting of September 5-9, in Detroit.

Crank-case ventilation and control of jacket-water temperature by thermostats have both materially contributed to the elimination of the water vapor formed in the products of combustion of the automobile engine. This removal of the water vapor prevents the condensation of this liquid saturated with sulphur oxides and, therefore, greatly reduces the corrosive effect of the dilute acid on the engine parts. Although the devices recommended are believed very helpful, Mougey concludes that far too many cars are still not so equipped and an immediate increase in the sulphur content of a motor fuel would not be in the best interest of the industry or of the public at this time.

Diggs' engine tests representing 60 to 75 hours' running time for each series, indicates the following conclusions: "(1) When using a gasoline of 0.040 per cent sulphur there was no corrosion of wrist pins, etc., and the water condensed in the crank case contained no free acid; but did contain some $FeSO_4$. (2) When using a gasoline of 0.151 per cent sulphur the corrosion was very appreciable and the water in the crank case contained free H_2SO_4 in small quantities. (3) When using a gasoline of 0.458 per cent sulphur the corrosion was very serious and the crankcase water quite acid."

The effect of knock suppressing and knock inducing substances on fuel combustion was considered by R. E. Schaad and C. E. Boord. They presented additional data to support their earlier conclusions that a knock suppressor in an explosive mixture of air and fuel increases the current required for ignition when a hot wire is used, whereas the presence of a knock inducer decreases the required current (wire temperature).

Safety and Production in the Chemical Engineering Industries

By J. E. Hannum

Director of Safety and Production Study, American Engineering Council

DESPITE the effective safety work that has been carried on in American industry during the past decade, recent years have apparently seen an increase in the aggregate number and severity of accidents. This alarming situation was recognized by the National Bureau of Casualty and Surety Underwriters, and it led to the extension of an invitation to the American Engineering Council to undertake a study for the primary purpose of determining whether an increasing industrial hazard is inevitable or whether it can be controlled.

Early in 1926, the American Engineering Council appointed a Committee on Safety and Production to carry out such a study. The work has been completed and the final report prepared by the Committee will shortly appear as a book entitled "Safety and Production," published by Harper and Brothers. Industrial executives need no longer be in doubt as to the effect of accident prevention activities upon their production programs. The mass of evidence which has been accumulated and is presented in this report, establishes the truth of the common belief that "a safe factory is an efficient factory, and an efficient factory is a safe factory."

Utilizing this assertion as a thesis, the Committee directed its investigation toward a determination of the relationships of safety and production. The situation in regard to safety was evaluated from the experience records of a large number of plants, and this condition was analyzed and compared with the ascertainable achievement in production. Rates of production on the one hand, and of accident frequency and accident severity on the other, were made the comparable or contrasting quantities.

No effort was made to determine the direct causal relationships between the factors which influence the accident and production rates. The impracticability of doing so was recognized as due to the impossibility of definitely separating a multiplicity of factors, many of which affect both the accident and the production rates. Hence, the requirements of the study have been met by collecting five major items of information which were obtained for as long a period as reliable records were available. These were: (1) average number of employees per year, (2) number of man-hours worked per year, (3) annual production, (4) number of lost time accidents per year, and (5) number of days lost due to lost time accidents per year.

The number of man-hours worked was used in each case as the common denominator for rates of production, accident frequency and accident severity. The numerators of the respective rates were the quantity of production, the number of accidents and the number of days lost. Thus, comparable rates were obtained for each company and for numerous industrial groups.

The report is very comprehensive in its scope, in as much as it encompasses the experience of 14,000 plants, aggregating over 122,000 company-years. In 1925, these companies employed two and one-half million workers, or one-quarter of the industrial wage earners of the country. The total exposure aggregates 13 million man-years, or nearly 55 billion man-hours. This experience covers 120 product classifications grouped as follows: cement; chemical; coal mining; coke; electric light and power; electric railways; gas; iron and steel; lumber; machine building and metalworking; men's clothing; paper, pulp, and paper products; quarrying; steam railways; telephone and telegraph; textile; woodworking; and miscellaneous.

The following data includes only the Committee's findings with respect to the industries, which are strictly of a chemical engineering nature. Five distinct methods were utilized in analyzing these data, viz.—(1) levels of performance with regard to safety and production are established to indicate the zones of possible improvement; (2) trends of accident frequency and accident severity in terms of production are shown; (3) the net changes in both the accident and production rates are indicated for two significant years, 1922 and 1925; (4) the productive time and value lost, as a result of industrial accidents, is indicated; and (5) the increases or decreases in the rates of production, accident frequency, and accident severity, in terms of man-hours, are determined by the least square method, and trends of these rates are shown graphically.

Chemical Industry. There has been a marked increase in the rate of production during the last five years in a representative portion of the chemical industry. This accomplishment has been attended with a reduction in the accident frequency rate, which declined faster than the production rate increased. A large reduction occurred in the severity rate of some product groups during the same period. This decline was not as general, however, as was the production rate increase and the frequency rate decrease.

Thirty-five chemical companies co-operated in the study, by supplying their accident and production experience from plant records. The product groups represented

are: acids and heavy chemicals, bleaching and dyeing, dyes and dye intermediates, explosives, paints and varnishes, petroleum refining, soap, and tobacco by-products.

The combined experience of three large companies manufacturing acids and heavy chemicals is shown in Fig. 1. An increase of 24 per cent in the production rate occurred from 1921 to 1925. This was accompanied by a decrease of 43 per cent in the accident frequency rate and also a decrease of 48 per cent in the accident severity rate.

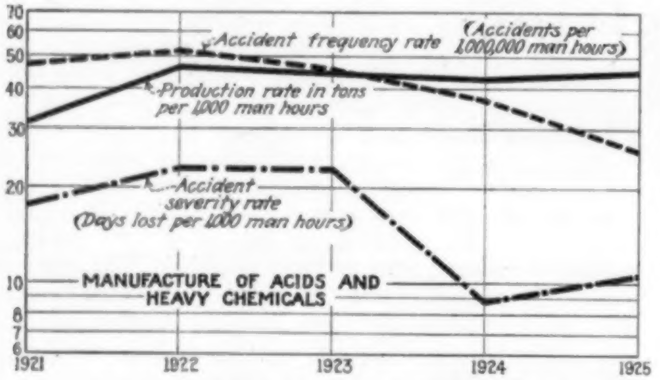


Fig. 1—Accident Frequency, Accident Severity and Production Rates from 1921 to 1925 in the Plants of 3 Companies Manufacturing Acids and Heavy Chemicals. Number of Employees 4,278

Fourteen chemical companies manufacturing explosives, with 2,035 employees, experienced an increase of 14 per cent in the production rate, from 1920 to 1924, a decrease of 69 per cent in the accident frequency rate, and a decrease of 64 per cent in the accident severity rate as indicated in Fig. 2.

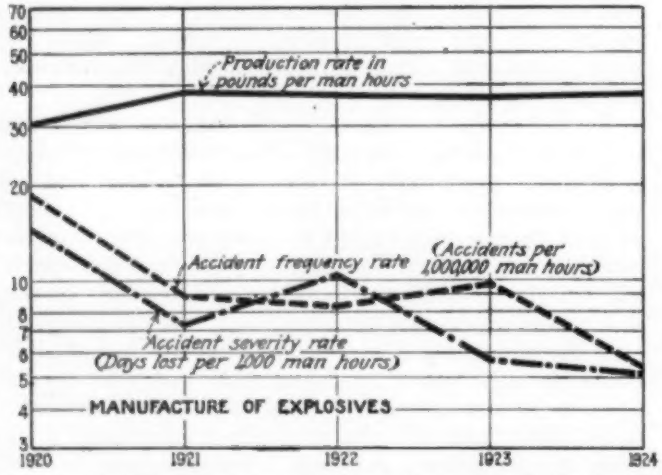


Fig. 2—Accident Frequency, Accident Severity and Production Rates from 1920 to 1924 in the Plants of 14 Companies Manufacturing Explosives. Number of Employees 2,035

The manager of a company manufacturing heavy chemicals, which has had organized safety work since 1914, stated that: "As the safety campaign grew from year to year, production generally increased and efficiency improved in a marked degree." The accident frequency rate in 1925 shows a reduction of 82 per cent from the rate in 1914. The accident severity rate in 1925 is 85 per cent lower than the rate in 1914.

An official of a tobacco by-products company stated: "Speaking broadly, we find that the cost of safety work has amply repaid us in decreased cost of accidents and in an improvement in the general tone of morale throughout the plant."

Cement Industry. Data for the cement industry were compiled by the Portland Cement Association. The statistics are for six years, from 1920 to 1925, and cover the experience of 120 plants, employing approximately 35,000 workers. These plants produced in 1925, 144,500,000 barrels of Portland cement, or 90 per cent of the output of the United States. The aggregate experience is 720 company-years, 210,000 man-years, and 630,000,000 man-hours.

The performance of this industry shows a steadily increasing rate of production, simultaneously accompanied with marked decreases in accident frequency and severity rates. The production rate, expressed in barrels per 100 man-hours, increased 32 per cent during the six year period. The rate for 1920 is 106.5 barrels per 100 man-hours, and for 1925, it is 148.4 barrels per 100 man-hours.

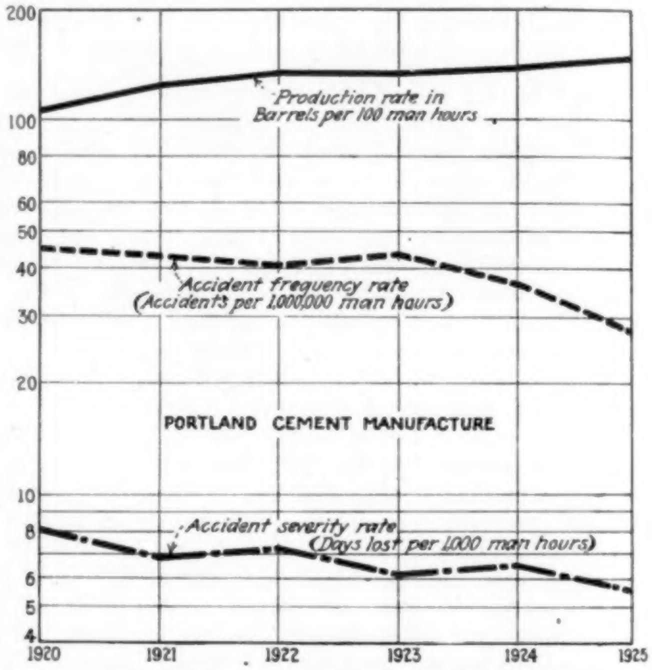


Fig. 3—Accident Frequency, Accident Severity and Production Rates from 1920 to 1925 in 120 Plants Manufacturing Portland Cement. Number of Employees 35,000

The accident frequency rate decreased 29 per cent, from 44.7 accidents per 1,000,000 man-hours, in 1920, to 27.5, in 1925. There was practically the same decline in the accident severity rate, the decrease being 30 per cent, from 8.02 days lost per 1,000-man-hours, in 1920, to 5.52, in 1925. This is shown graphically in Fig. 3.

Even greater decreases in the accident rates occurred when the frequency and severity of accidents are expressed in terms of production. The reductions on this basis are: accident frequency rates 49 per cent; accident severity rates of 47 per cent.

The rates for one individual company, manufacturing cement, are even better than those for the group, and just as uniform, although based on a relatively small exposure. This company employs between 500 and 1,000 workers. Organized safety work was started in 1919. The rates for the six years, from 1920 to 1925, are shown below as follows:

	1920	1921	1922	1923	1924	1925
Production rates in barrels per 100 man-hours.....	133.0	146.0	170.0	178.5	186.5	194.5
Accident frequency rates in accidents per 1,000,000 man-hours	60.2	25.7	27.6	24.1	22.5	9.9
Accident severity rates in days lost per 1,000 man-hours	8.32	0.61	18.3	0.35	0.86	0.46

The production rate increased 46 per cent, the accident frequency rate decreased 80 per cent, and the accident severity rate decreased 91 per cent. It seems reasonable to suppose that what has been accomplished by one company can certainly be accomplished by others in the same field.

Paper and Pulp Industry. The paper and pulp industry is represented in the report by the experience of fifty-three mills, with 29,120 employees. The accident and production performance of these companies is as favorable and as uniform as that of any industry studied. The rate of production, for the period covered, increased approximately 20 per cent, while simultaneously the accident frequency and severity rates have each decreased approximately 30 per cent. A number of small mills have demonstrated that productivity can be materially increased while the accident rates are very considerably decreased.

The analysis of the data received from fifteen plants employing 7,387 workers in the paper and pulp industry, is shown in Fig. 4. The rate of production has been steadily increased 19 per cent during the five year period from 1921 to 1925, while simultaneously the accident frequency and accident severity rates have been reduced 18 per cent and 21 per cent respectively.

The combined experience of three companies manufacturing corrugated cartons, with 466 employees, shows an increase of 17 per cent in the rate of production from 1923 to 1925, accompanied by decreases of 38 per cent and 52 per cent in the accident frequency and accident severity rates respectively. For the same three year period, three companies manufacturing newsprint, with 6,158 employees, had an increase of 22 per cent in the rate of production, accompanied by decreases of 18 per cent and 23 per cent in the accident frequency and accident severity rates respectively.

Companies manufacturing fine writing paper have not effected reductions in the accident rates comparable to the reductions made by the industry generally. The combined experience of three companies manufacturing fine writing paper, with 1,996 employees, shows increases of 41 per cent and 96 per cent in the accident frequency and accident severity rates respectively during the period from 1921 to 1925, while the rate of production increased 16 per cent. However, one company, from which records were received, has demonstrated that good production and good accident performance are consistent and possible of attainment.

Findings and Recommendations of the Committee. In presenting its report of "Safety and Production," the Committee on Safety and Production of the American Engineering Council feels that the remedial measures recommended and the improvements clearly possible deserve the thoughtful consideration of industrial executives.

One phase of the study, not touched on here, discloses such a close relationship between safety and production as to indicate that it is impossible for a plant to have continued increases in productivity unless it reduces, at the same time, its accident rates. This led the Committee to formulate a fundamental of management: "Maximum productivity is dependent upon the reduction of accidents to an irreducible minimum."

Although the experiences of numerous individual companies clearly show that material reductions in accident rates can be simultaneously obtained with increases in production rates, yet it has been found that organized safety work is being carried on in only a relatively small percentage of industrial plants. It is evident, that many industrial executives have not given to accident prevention that degree of attention and direction that its economic and humanitarian significance warrants. Some executives feel that, because of compensation carried, their responsibility has been met, hence they do not concern themselves with accident prevention.

The Committee is convinced that the initiation of accident prevention is as much a responsibility of the major executives of industry as is the initiation of improvements in productivity; it therefore recommends that the same executive direction and control be given to decreasing accidents as is given to increasing productivity. Further recommendations of the Committee are:

"That those agencies which collect and disseminate

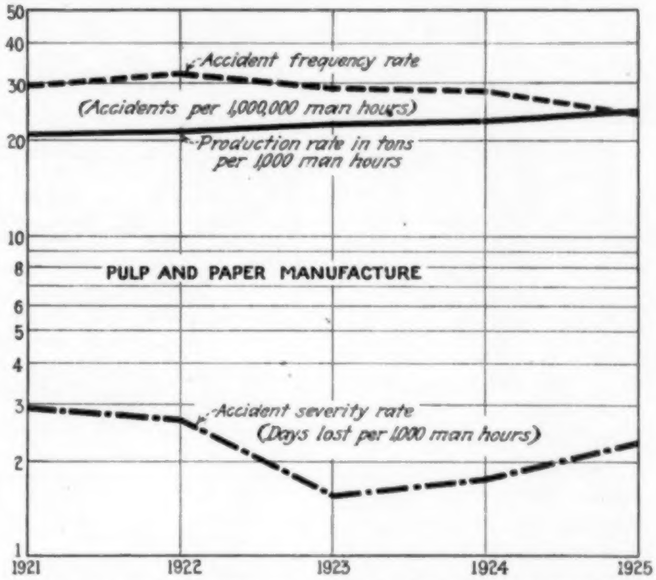


Fig. 4—Accident Frequency, Accident Severity and Production Rates from 1921 to 1925 in the Plants of 15 Companies Manufacturing Paper, Pulp and Paper Products. Number of Employees 7,387.

accident statistics adopt uniform terminology and standardize their records so that they may be compiled on a comparable national basis.

"That the executives of those plants having high accident frequency and severity rates, initiate, direct and control ways and means of lowering such rates to at least the low rates obtained by other plants in their industry.

"That industrial trade associations, engineering societies and other agencies concerned with the improvement of industrial operation, bring to the attention of their members the necessity of improvement in safety performance as a vital step in the strengthening of their industrial position.

"That industrial trade associations secure, compile and analyze accident statistics for the purpose of determining the lowest accident rates possible of attainment for their respective industries.

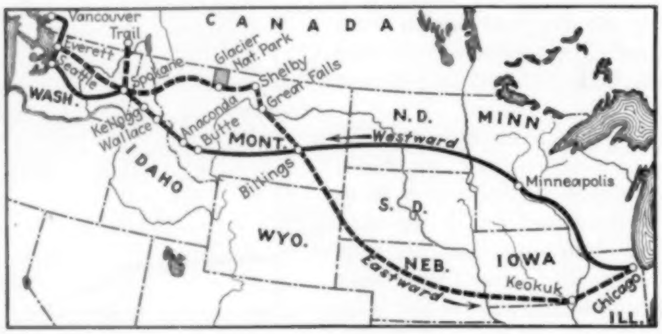
"That industrial trade associations endeavor to secure such action on the part of executives of their respective industries as will result in each plant having the lowest accident rates obtainable."

The Committee advances these remedial measures, with confidence that all industrial executives will recognize their responsibility in the matter of accident prevention, and with the firm conviction that the accident situation throughout American industry will be materially improved by the universal acceptance of the Committee's recommendations.

Electrochemical Society Visits the Northwest

Inspects copper, zinc and lead refineries, hydroelectric plants and electrochemical industries in Montana, Washington, British Columbia and Iowa

Editorial Staff Report



TO THE electrochemist the rapid development of electrometallurgy and hydroelectric power in the Northwest has been of increasing interest and importance. The recent 18 days' tour of the American Electrochemical Society from Chicago to Vancouver and return has been acclaimed by its participants as an unparalleled success. Of the several factors that contributed toward the success of the undertaking, the principle underlying all of them was the cordial reception at the plants and the free interchange of technical data and suggestions.

General Observations. It was a surprise to many of the visitors that the maximum available water power of the States of Washington, Oregon, Idaho and Montana is almost equal to that of all the other states put together. An abundant supply of commercially important minerals has made the Anaconda Reduction works of Montana the largest in the world among non-ferrous establishments. Here in the Northwest and in the adjoining districts of British Columbia are located the largest producers of electrolytic lead and zinc. By the first of next year the Anaconda company will be turning out almost 500 tons of pure electrolytic zinc per day. The supply of lumber in the State of Washington far exceeds the demand. A new industry for the utilization of wood byproducts is just in its infancy. The synthetic ammonia plant of the Pacific Nitrogen Corporation, located at Seattle, is in commercial production. The U. S. Geological Survey estimates the coal resources of Washington and Montana at several hundred billion tons, all within 3,000 feet of the surface.

Leaving Chicago on Sept. 4, the first stop was made at Minneapolis where Professors Charles A. Mann and S. C. Lind had arranged an elaborate program. After a tour through the delightful residential sections and parks of Minneapolis the party of electrochemists proceeded to the University and Bureau of Mines. At the laboratories of the latter, tests on high manganese Minnesota ores were in progress under the dirction of T. L. Joseph and S. P. Kinney. The ores were smelted in a 6-ton blast furnace and the high manganese pig was then transferred to an open-hearth furnace where there is produced through selective oxidation, a low sulphur steel and a slag low in phosphorus but containing manganese and iron in proportion suitable for the production of commercial grade ferromanganese.

Professor S. C. Lind, president of the American Electrochemical Society, presided at the well attended and enthusiastic meeting in the large lecture hall of the School of Chemistry, University of Minnesota. The introductory paper by I. J. Moltkehansen, Norwegian electrometallurgist, dealt with the developments of the electrochemical industries in Norway during the past 25 years. Of the 2,000,000 hydroelectric horsepower generated in Norway almost half is used in the electrochemical industries. In the discussion Eric Lof of the American Cyanamid Co. referred to the new aluminum plant built there by the Aluminum Company of America.

Electrodeposition of Rubber. Dr. S. E. Sheppard of the Eastman Kodak Company gave an illustrated address on the electrodeposition of rubber—a process which is now a marked commercial success. Discussing the electrophoresis of rubber latex Dr. Sheppard showed that this is inversely proportional to the actual conductivity of the solution. The movement of a true ion and the electrophoresis of a colloidal particle are each proportional to the slope of the potential and likewise to the time. Best results to date have been obtained by depositing the rubber (anodically) on a metal such as zinc which is anodically corrodible and forms stable oxides compatible with the rubber deposit. With such metals, oxidative changes of the latex particles adjacent to the anode surface are largely avoided. Copper anodes produce cuprous ions which lead to a very rapid breakdown of the rubber. Electro-deposited rubber may be readily vulcanized. Alfred C. Loonam of Guggenheim Brothers, in commenting upon Dr. Sheppard's results, suggested that with our new knowledge of the behavior of organic colloids, a study of the electrolysis of colloidal metal solutions would be of interest. It might be possible to deposit

heavy layers of metal in much shorter time than is done at present.

Thermionic Rectifiers. J. Slepian of the Westinghouse company reviewed the development of the thin film rectifiers showing numerous oscillographs illustrative of their operation. From the characteristics of the new dry copper-oxide rectifier it might be expected that its life would be practically infinite. It has been operated continually and satisfactorily in trickle charge circuits for over 4 years.

Electrical Discharge in Ethane. S. C. Lind and George Glockler exhibited samples of a syrupy liquid obtained from ethane under the influence of a silent electric discharge of 12,000 volts. From the analyses of the gaseous reaction products it appears that there exists a parallelism between the reaction produced by electric discharge and condensation caused by alpha rays from radon.

Arriving at Butte, Montana, the electrochemists went down into the Leonard mine of the Anaconda Copper Mining Company. Chauncey L. Berrien, C. D. Woodard and G. A. Roush acted as guides. Thence the party was conducted to Anaconda where they were entertained at luncheon at the Montana Hotel. F. F. Frick presided. The afternoon was spent at the Reduction Works. It was striking to observe how the old Wilfley tables had rapidly given way to the much smaller flotation units. The final stages of the metallurgical operations, and the production of copper wire, are carried out at Great Falls, Montana, where the electrochemists stopped on their return trip ten days later.

In the Coeur d'Alene District

Electrolytic lead and electrolytic zinc were the chief attractions of Kellogg, Idaho. The morning was spent at Wallace, only a few miles from Kellogg, inspecting the mines and mills of the Federal Mining & Smelting Company and the Hecla Mining Company. At Kellogg, the Sullivan Mining Company is erecting a 150-ton zinc plant and the first 50-ton unit being almost completed. The Tainton-Pring electrolytic process will be used, charaterized by high acid and high current density as compared with low current density and low acid which are standard at Great Falls and Trail. The zinc concentrates are roasted at comparatively high temperature giving rise to high percentage of zinc ferrate. A magnetic separator divides the zinc oxide from the ferrate. The latter, which is soluble with difficulty in sulphuric acid solutions, is treated with the high acid (280 grams per liter) spent electrolyte from the cells. As the reaction slows down the final neutralization is carried out with the oxide portion of the roasted blende. The pulp is then filtered in Burt filters and the solution agitated with zinc dust. This precipitates copper, cobalt and cadmium, after which the solution is filtered in presses and passes on to the electrolytic cells. The current density is 100 to 120 amperes per sq.ft., voltage 3.5. Lead anodes and aluminum cathodes are used. An electric furnace melts the stripped cathode sheets. The cast slabs analyze 99.99 per cent Zn.

A unique plant produces the electrolytic lead. The cell is of the diaphragm type, with graphite anodes, steel cathodes and using the chloride solution. The lead is deposited on the rotating steel cathodes as a spongy mass which is continuously removed. The chlorine leaving the anode compartment passes into a suspension of lime and the chloride solution produced is fed into the tank holding the lead-rich electrolyte which has passed over fresh roasted ore. Soluble sulphates are precipitated as calcium sulphate.

The next four days the electrochemists spent in visits to a number of the larger power plants of the Northwest, among them the long Lake station near Spokane, the White River Power plant with its 460 foot head, near Seattle and the two Buntzen plants on Lake Buntzen, British Columbia.

Technical Session at Vancouver

The reception given the electrochemists at Vancouver was undoubtedly the most cordial and elaborate. The American concert at the Strand, the delightful luncheon tendered by the mayor and the trip on the launch "Fispa" through the romantic scenery of Lake Buntzen are incidents which will be long remembered by the participants of the tour.

President S. C. Lind presided at the technical session held at the Georgia Hotel, one of the finest hotels on the Pacific Coast. The first paper by David Caesar, presented by Dr. A. W. Burwell, described experiments on the electrolytic preparation of para-aminophenol. Caesar found that a copper gauze cathode in combination with a Duriron anode and a current density of four to five amperes per square decimeter gave the best yields. A paper by Colin G. Fink and Charles L. Mantell described a simple laboratory hydrogen-oxygen generator, particularly serviceable where a continous stream of gas is required over long periods of time. Dr. Konrad Teufel, one of the notable foreign delegates in the electrochemists' party, submitted the results of large scale tests carried out at Leverkusen, Germany, on the electrodeposition of zinc. Teufel finds, contrary to both Anaconda and to Tainton practice, that high acid concentration and low current density is more efficient than either "high acid-high current density" or "low acid-low current density." For example, at 40 amperes per square foot, upon increasing the free acid from 100 up to 200 g./L. the current efficiency is reduced by 3 per cent, but the energy efficiency is increased by almost 7 per cent.

Following the formal part of the program, Professor G. A. Roush outlined briefly the various metallurgical steps in the refining process at Great Falls. The meeting was then thrown open to a general discussion on low-temperature carbonization of coal, M. Leopold Herry of Belgium, an authority in this field, opening the discussion. Many of the local engineers were deeply interested in this topic and recounted freely of their own experiences.

Electrolytic Refining at Trail. An interesting plant from an electrochemical and engineering point of view is that of the Consolidated Mining & Smelting Company at Trail, B. C. The ore is a complex copper-lead-zinc-iron sulphate carrying appreciable quantities of silver and gold. The daily output of the plant approximates 400 tons of lead, 280 tons of zinc, 60 tons of copper, 20,000 oz. of silver and 80 oz. of gold.

The Betts process is used in the lead refinery, the electrolyte being a solution of lead fluosilicate, about 130 g./L. of hydrofluosilicic acid and 90 g./L. of lead. The current density is 17 amperes/sq.ft.; the voltage 0.40. In the zinc refinery the electrolyte contains 150 g./L. Zn, and 135 g./L. free sulphate acid. Lead anodes and aluminum cathodes are used with a current density, 27 to 30 amp./sq.ft., voltage 3.6. Power consumption is 1.55 kw.-hr./lb. Zn. An elaborate purification system is installed: iron, arsenic, copper, cobalt, nickel, cadmium, antimony, are removed before the spent electrolyte, that has passed over fresh ore, returns to the electrolytic cells. The cell solution is decidedly pink due to the manganese, which is a very essential ingredient.

The electrochemists were particularly fortunate in having sunny weather throughout the tour. The cheerful day at Glacier afforded ample opportunities to view the natural splendors of the great National Park. The next morning found the party at Great Falls where the electrolytic zinc and cadmium plants were of particular interest and attraction. The zinc plant is the largest of its kind in the world. The purification of the zinc solution is a fine example of chemical engineering skill in carrying out ideas that have originated in the laboratory.

On the way to Keokuk a brief stop was made at Omaha to visit the A. S. & R. lead smelter and refinery. This is the largest lead producer in the world. In the electrolytic refinery the Betts process is employed. An important byproduct is bismuth which is recovered from the slimes by electrolytic means using a chloride solution.

Electrochemical Industry at Keokuk

The final day of the tour was spent at Keokuk. At the United Lead Company's plant the Frary cells were observed in operation. They are about 3 ft. in diameter. The cathode is a molten 2-ton mass of lead, the anode a carbon electrode 10-in. in diameter. Each cell takes 2,000 amperes at 10 volts. About 48 hours are required to bring the calcium-barium content up to 1.5 per cent. The alloy is used extensively as a bearing metal.

Cells similar to the Frary cells are operating on the rejuvenation of type metal dross, a product rich in tin being obtained. Of particular interest was the new carbide furnace equipped with 3 Soderberg electrodes 4 ft. in diameter.

At the plant of the Keokuk Electrometals Company 15 per cent and 45 per cent ferrosilicon was being manufactured in two 12,000-ampere 70-volt box-type electric furnaces. The power is furnished by the Mississippi Power Company from its famous plant at the Keokuk dam. Plans are drawn for a large extension to the plant to meet the increasing electrochemical demand.

T. F. Wettstein and his able committee carried out the details of the program with dispatch so as to allow time at Keokuk for the third and final technical session. Three papers were presented, Dr. A. W. Burwell presiding. The first paper by Dr. A. Kenneth Graham reported a detailed study of the structure of electrodeposited copper. Microphotographs showed how the structure is dependent upon the metal concentration, acid concentration, current density, temperature and addition agents.

The second paper by Professor O. P. Watts reported that lead anodes were more satisfactory than ferrosilicon, ferrochrome or other metal anodes for commercial chromium plating from chromic-acid solutions. Detailed tabulated results were presented. The final paper on the program by Dr. Remo Catani of Rome was entitled "The Calculation of Electric Furnaces," and presented by H. R. Lee of the Union Carbide Company. Methods were outlined for the mathmetical determination of the various furnace operating factors affording a ready means of checking and controlling power efficiency, temperature, etc.

Following the technical session the members adjourned to the Lakeview Club, across the river at Milton, Illinois, where they were entertained at dinner by the local committee. Chicago was reached the next morning and the party of electrochemists dispersed with great reluctance.

Approximately sixty members and guests of the American Electrochemical Society made the Northwest trip. It is significant that five members, Drs. Herry and Moltkehansen of Belgium and Drs. Khern, Staib and Teufel of Germany, crossed the Atlantic in order to take advantage of the opportunity to see American electrochemical industries. Those who participated in the trip are as follows:

Mr. and Mrs. Lawrence Addicks, Consulting Engr., New York City.
L. K. Armstrong, Consulting Engr., Spokane, Wash.
R. L. Baldwin, Republic Carbon Co., Niagara Falls, N. Y.
Vernon R. Burr, American Bank Note Co., New York City.
Dr. and Mrs. A. W. Burwell, Buffalo, N. Y.
Helen E. Dalling, American Electrochemical Society, New York City.
Henry Davis, U. S. Foil Co., Louisville, Ky.
G. L. Davison, Southern Ferro Alloys Co., Chattanooga, Tenn.
T. H. Donahue, Anaconda Lead Products Co., East Chicago, Ind.
Dr. and Mrs. Colin G. Fink, Columbia University, New York City.
A. E. Gibbs, Penna. Salt Mfg. Co., Philadelphia, Pa.
Mr. and Mrs. J. H. Goodwin, Consulting Engr., Troy, N. Y.
H. C. Graebner, E. I. Du Pont de Nemours Co., Wilmington, Del.
Alex Heilborn, Niagara Falls, N. Y.
Leopold Herry, Director, Central Electrique des Flanders, Langerbrugge, Belgium.
Geo. B. Hogaboom, Hanson & Van Winkle Co., Newark, N. J.
G. Byron Hogaboom, Student, Columbia Univ., New York City.
Mrs. Ernest G. Jarvis, Niagara Falls Smelting & Refining Co., Niagara Falls, N. Y.
Carl Khern, Fabrikdirektor, I. G. Farbenindustrie Aktiengesellschaft, Leverkusen, Germany.
Walter G. King, Jr., Chem. Engr., Columbia Univ., New York City.
Arthur H. Kopp, Otto Sprenger Corp., New York City.
August Kuhlmann, Electrometallurgical Corp., Niagara Falls, N. Y.
H. R. Lee, Union Carbide & Carbon Co., New York City.
Dr. and Mrs. S. C. Lind, Univ. of Minnesota, Minneapolis, Minn.
A. L. Littauer, Combustion Utilities Co., New York City.
Eric A. Lof, American Cyanamid Co., New York City.
Alfred C. Loonam, Guggenheim Bros. Lab., New York City.
P. A. McTerney, General Electric Co., Schenectady, N. Y.
Dr. and Mrs. Chas. A. Mann, Univ. of Minnesota, Minneapolis, Minn.
J. P. Marble, Marble-Nye Co., Worcester, Mass.
Mr. and Mrs. E. E. Meisekothen, French Battery & Carbon Co., Madison, Wis.
R. E. Molley, American Boron Products Co., Buffalo, N. Y.
I. J. Moltkehansen, Consul Honaire de France, Brussels, Belgium.
L. W. W. Morrow, Managing Editor "Electrical World," New York City.
Miss Edythe Potts, Philadelphia, Pa.
O. C. Ralston, U. S. Bureau of Mines, Washington, D. C.
Frank A. Reynolds, Vanadium Corp. of America, Bridgeville, Pa.
G. A. Roush, Montana State School of Mines, Butte, Mont.
Ernest Scheller, U. S. Foil Co., Louisville, Ky.
Mr. and Mrs. Pedro G. Salom, Consulting Engr., Philadelphia, Pa.
Mrs. P. G. Salom, Jr., Philadelphia, Pa.
F. F. Schuetz, Patent Attorney, New York City.
Mr. Schuetz, Student, Cornell University, Ithaca, N. Y.
Mr. and Mrs. R. L. Shepard, The C. B. Shepard Co., Detroit, Mich.
Dr. S. E. Sheppard, Eastman Kodak Co., Rochester, N. Y.
Karl Staib, Chemist, I. G. Farbenindustrie Aktiengesellschaft, Bitterfeld, Germany.
Konrad Teufel, Asst. Mgr., I. G. Farbenindustrie Aktiengesellschaft, Leverkusen, Germany.
Mr. and Mrs. B. L. Thompson, The Solvay Process Co., Syracuse, N. Y.
G. R. Thompson, Patent Attorney, New York City.

High Points in Operating a Chamber Sulphuric Acid Plant

By A. T. Newell
Superintendent, Acid Department, United Zinc Smelting Corporation, Moundsville, W. Va.

MANY sulphuric acid plants in the United States are not securing the maximum possible production at the lowest possible cost per ton, because some one or more of the factors which guarantee the best results, have been disregarded or overlooked. It is needless to say that there are in operation today many plants which could be made to enjoy greatly improved operation as a result of minor changes in equipment, while others would require the expenditure of a number of thousands of dollars before the most favorable operation could be assured. This article takes into account only those plants which, although properly designed, fall short of full efficiency through faulty or careless operation.

The objective of all chamber acid plant operation is:

1—Maximum daily tonnage.
2—High yield.
3—Low niter consumption.
4—Proper class of labor to secure the lowest possible cost per ton.

Maximum daily tonnage is secured first, through using the full capacity of burning or roasting equipment, for brimstone, pyrites (iron or copper), or zinc blende as the case may be; second, through converting sulphur dioxide to sulphur trioxide completely; and third through condensing the sulphur trioxide efficiently in the lead chambers.

In order to get a high daily tonnage through any type of burner it is necessary to keep the burner in the best of condition. Therefore cleaning is a most important item. In the case of the Glens Falls Brimstone Burner which is normally operated half full of molten brimstone, cleaning is automatic, for the ash and dirt floats and drips out the end of the burner. On all other burners cleaning must be a regular and systematic procedure and it must be done in a manner that will least interfere with the constant and uniform flow of sulphur dioxide into the chamber system.

In the case of pyrites fines burners such as the Wedge, McDougall or Herreshoff, it is necessary to watch constantly the drop holes and gas passages and to keep them open. The accretions on the central shaft and on the roof of the hearth must be regularly barred down to prevent their growing to a size which might, if they dropped, result in the danger of breaking a rabble arm. In addition to this the hearth floor must be chiseled out regularly to prevent a crust from building up which would cause the rabbles to drag unnecessarily and throw undue strain on the driving mechanism or even on the arch itself.

In connection with the burners it should be mentioned that when nitrate of soda is introduced into pots in the combustion chamber or flue, constant inspection and care must be taken to prevent niter cake from overflowing the pot and solidifying below. This has happened in more than one instance and has filled up the combustion chamber to such an extent that it prevented complete combustion. This resulted, naturally, in a decreased plant capacity, and caused high niter consumption, as the nitrate of soda could not be heated to a sufficiently high temperature for complete decomposition. A weekly draught record kept from readings taken at several points throughout the system with a simple water manometer will immediately indicate a stoppage from this cause or any other developing in any flue or passage. Serious plugging of the flues and towers by sublimation and dust from the burners may thus be anticipated in time and the proper steps taken.

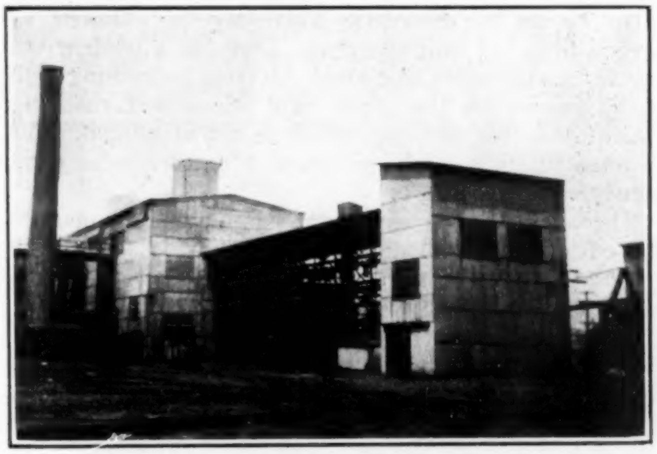


Fig. 1—Hegeler Zinc Roasting Kiln. United Zinc Smelting Corporation

It may seem unnecessary to mention in connection with equipment that there should always be maintained in store at least the more important repair parts so that any breakage can be quickly attended to. And yet there are plants which fail to do this and meet with a great deal of expense and delay in wiring for new parts and then waiting for them.

Returning to the fines type of burner we must emphasize the greater capacity which will be obtained if attention is paid to the fineness and quality of the raw material. Granular fines of from $\frac{1}{20}$ in. to $\frac{1}{4}$ in. will ordinarily give the best results. Fines containing an exceptional amount of dust will have a tendency to fuse and produce a sticky mass that may cause trouble with the rabbles. Dusty material will also be carried over into the towers and chambers to a greater extent, causing stoppage of the towers, and contamination of the acid. On the other hand coarser pyrites, say $\frac{1}{2}$ in., will not roast rapidly and when discharged from the burner will be found to have a central core of sulphide. The same

thing may result if too much moisture is present in fines of the proper size. The pyrites should contain no more moisture than can be eliminated across the top or dryer hearth. If moist material is introduced into the top roasting hearth, a considerably longer time will elapse before roasting begins and the capacity of the burner will be reduced accordingly.

In order to secure a low sulphur content in the roasted ore, which is necessary for good recovery at the retort furnaces, the time of rabbling must be varied, the speed of the fans changed, and the amount of air introduced directly into the hearths by the blowers increased or decreased from time to time. The charge may continue fairly coarse for several hours or longer, during which time the rakes pull light loads and permit the ore bed to build up on the hearths. This may be followed by several hours of dust charging. Dust has a tendency to run before the rakes like water, carrying everything with it. Thus we see that there may be an ever changing condition within the kiln, which is not at all conducive to even roasting conditions or to a uniformly or completely roasted ore.

The second step in securing maximum daily tonnage—the efficient conversion of sulphur dioxide to sulphur trioxide, depends in the main upon the following important factors:

Maintenance of a constant quantity and quality flow of gas through the system with as nearly as possible a fixed percentage of SO_2 is absolutely requisite. This is done by burning brimstone or other sulphur bearing material at a fixed rate and supplying a close regulation of draught.

MAINTENANCE of a constant flow of nitrous vitriol over the Glover tower is equally important. Variation of this stream results in a variation of nitrogen oxides from this source fed to the chamber system, and unless there is excess storage for nitrous vitriol, this must be the result of a variation in the streams over one or more Gay Lussac towers, which materially interferes with the recovery of nitrogen oxides.

Maintenance of the strength of the mixture of nitrous vitriol and chamber acid at the distributors on the Glover tower at as near 55-56 deg. Bé. as is possible, coincident with the concentration of the final product to 60 deg. Bé. or other desired strength is obviously required.

In line with the necessity for introducing the oxides of nitrogen into the chambers uniformly and continuously, the make-up, when potting nitrate of soda, must be added at regular and short intervals to produce an even flow of oxides and an intimate mixture with SO_2 so that no "pale" spots will result. Similarly, whether the oxide requirement is supplied by potting, by the use of nitric acid or by ammonia oxidation, sufficient quantity must be used to insure complete conversion. In practice this is gaged largely by maintaining a difference of temperature between the first and last chambers which will cause the nitrous vitriol either to hold or build in strength without the loss of oxides as shown by excess yellow fumes at the exit stack.

The third step in securing maximum daily tonnage is efficient condensation. To do this it is necessary to maintain the maximum possible percentage of SO_2 in the burner gases with only sufficient oxygen to insure complete conversion, plus a slight excess for the reactions in the Gay Lussac towers. This makes efficient use of chamber space certain. If weak gases should be permitted to enter the chambers (except where it is necessary in the case of byproduct plants) valuable space which should be utilized for reaction would be taken up by an unnecessary and useless volume of inert gas. Then with the proper gas composition, efficient condensation is maintained by providing a sufficient water supply and introducing it into the chambers either as steam or as water mist, preferably the latter in summer. This supply is usually indicated as correct when the chamber drips read between 45 and 50 deg. Bé. Better condensation will result, especially in summer, when the chambers are properly ventilated so that the air moving around them will remove the heat of reaction as quickly as it is given off.

THE SECOND step making for efficiency in acid plant operation, namely high yield, is obtained, in part by correct regulation of draught at the burners or kilns to secure complete combustion without sublimation. This is done by bringing the fans to the proper speed and completing the regulation by means of the doors, port holes, slots, collars or other provided means, until perfect combustion is obtained together with the practically total elimination of fumes at the burners. It is necessary to keep in mind, however, that no more air than is necessary for complete combustion and oxidation is wanted, as this serves only to cut down the efficiency of the chambers.

Yield is likewise improved both by the introduction of the correct amount of oxides of nitrogen so as to prevent SO_2 or SO_3 leaving the exit as such and by the proper addition of water as a fine spray to facilitate the formation of sulphuric acid. Nitrate of soda in circulation is usually 20 to 25 per cent of the weight of the sulphur in the acid made daily.

Good yield, once it is established, is retained by proper maintenance on the equipment to prevent leakage of gas from chambers under pressure, leakage of acid from chamber pans, and leakage from flues, tanks, pumps or acid lines.

Of equal importance in the economical operation of the plant are accurate plant records. All acid shipped or used in other departments of the plant must be carefully weighed and tested. Hydrometers throughout the works must be tested regularly against a known standard to make sure they are correct. Similarly the accurate weighing of brimstone or other material charged is requisite. If error exists intentionally or otherwise, the yield will suffer and future operations will be predicated on unreliable operating results.

WE NOW come to the third point in acid plant operation, namely, low niter consumption. We are, of course, assuming that the Gay Lussac towers are properly designed, with sufficient absorbing surface and volume.

First, the process must be so controlled by introducing just the correct amount of oxides of nitrogen that the SO_2 at the point of entrance to the first Gay Lussac tower is reduced to 0.02 per cent to 0.1 per cent. This figure varies somewhat for different plants. The result is obtained by carrying a predetermined temperature difference between the first and last chambers. This difference is usually from 100 to 120 deg. F. but varies for different plants and also to some extent, for the same plant during different seasons of the year. It must be determined by experiment, and must result in the main-

tenance of or the building of vitriol strength without an appreciable loss of unabsorbed nitrogen oxides from the stack.

Second, absorbing acid of the proper amount, temperature and strength must be supplied to the Gay Lussac towers so that good recovery of the nitrogen oxides used may result. A volume of three times the total daily production of 60 deg. acid is, according to usual practice, pumped per day over each Gay Lussac. The temperature of the acid should be preferably 100 deg. F. or less to secure the best results. In some plants where circulation acid is allowed to reach 175 deg., denitration has been known to occur when the nitrous vitriol coming from the second and third towers meets the hot gases from the chambers as soon as they enter the first Gay Lussac tower.

While it is true that 62 deg. acid will absorb oxides of nitrogen more readily than 61 acid and 61 will absorb better than 60 deg. acid, however the higher concentrations cannot be obtained in all plants due to the interference of other conditions. But circulation should not be permitted to run below 60 deg. Bé. except in severe climates where there is danger of freezing.

Third, low niter consumption is only obtained through the maintenance of the proper ratio of heat to the volume of nitrous vitriol and chamber acid entering the Glover tower, to secure complete denitration. The volume of nitrous vitriol flowing over the Glover must be made to vary with the heat of the gases entering. The higher the temperature of the gases, the greater will be the necessity for flowing a large volume of acid, because the temperature of these gases must be reduced to a point where the chambers will in no way be endangered before they leave the Glover. As pointed out above, when the resulting mixture of nitrous vitriol and chamber acid at the distributors is 55-56 deg. Bé., good conditions for complete denitration exist.

Fourth, the maintenance of steady and unchanging stream flows over all towers is required. The volume of nitrous vitriol used in the Glover together with pump capacity determines the total volume of acid that can be put over the Gay Lussacs. The chief requirement is that all Gay Lussac packing shall be wet. The gases must have the greatest possible opportunity, consistent with the tower surface provided, to come into contact with the absorbing acid. It is essential that the volume of the streams remain unchanged for the following reason. If the nitrous vitriol over the Glover amounts to 10 tons per hour and for some reason the stream over the first Gay Lussac is increased to 12 tons per hour, it is obvious that the Glover will secure inferior nitrous vitriol for a period equal to the time that increased flow continued over the Gay Lussac. In consequence of this a larger amount of nitrate of soda will have to be potted which will throw the system out of balance.

Fifth, niter consumption will be somewhat decreased by circulating the entire make of chamber acid over the Glover tower before shipping. This eliminates practically all the oxides of nitrogen which the chamber acid might contain.

Sixth, nitrate consumption is materially increased if the proper ratio of sulphuric acid to nitrate of soda in potting is not adhered to so that proper decomposition of the nitrate of soda may result. The requirement is also affected if the mixture is not properly heated. Acid to the amount of one and one-half to twice the weight of nitrate of soda potted is usually sufficient to insure decomposition. This proportion will also give a niter cake that can be easily handled. If the pots are installed in the gas flue, of course no control can be exercised. On the other hand if they are in an independent setting, they can be fired at will, light when potting is low and heavy when the demand is heavy.

THE FOURTH and last point in the operation of acid plants, the proper balance of labor to secure the lowest attainable cost per ton, is definitely tied up with the personnel of the plant. Personnel in an acid plant is much more important than commonly supposed. Many of the larger companies have realized this, however, and are providing first class men (when they can obtain them) for important jobs. Some of the smaller plants would reap proportionately large dividends by following suit. The use of mediocre operators will usually result in poor yield from some or all of the following causes: failure to introduce the specified weight of charge, neglect to observe, stop or report leaks, failure to judge the process properly, and finally the use of an incorrect amount of nitrate of soda which will eventually result always in a loss.

Fig. 2—Chamber Sulphuric Acid Plant. United Zinc Smelting Corporation

In order to secure efficient men who will stay on the job month after month, it is absolutely necessary to pay fair wages and to provide hours that do not make the operator an automaton who walks the chambers, writes down the results and makes no use of them, waiting only for his relief to come on so that he may go home. In addition to paying fair wages it will, almost without exception, pay any company well to furnish an extra incentive in the form of a bonus based on a certain niter consumption per lb. of product, a certain yield or both. One company operates quite successfully by giving its chamber operators a certain percentage of the value of the nitrate of soda saved above 3.5 per cent, a figure which was considered good from years of past operation. Nevertheless these chambermen by careful work and co-operation are able to reduce this figure materially and to benefit personally, at the same time saving money for their company.

If all or as many of the above points as are applicable are carried out as effectively as circumstances permit, savings cannot help but accrue. Those savings will point to others and the final result will be a close approximation to our original object, maximum daily tonnage, high yield and low niter consumption,—which three criteria, together with efficient labor, will give low cost per ton.

Compression of Steam for Process Heating

By Crosby Field

Consulting Engineer, New York, N. Y.

IN MY article entitled "Some Odd Applications of Steam," *Chem. & Met.*, Vol. 34, No. 9, September, 1927, the use of steam compression as a means of raising the pressure of available steam supplies was discussed. Mention was made therein of the investigation conducted by Dr. Alan E. Flowers and Mr. W. O. Durbin, under the author's direction.

The table given below shows in detail the calculations used and results obtained from this study. It is offered here as a guide to those confronted by the necessity of employing the expedient of steam compression in order to carry out their heating process in an economical manner.

Calculations for Determining the Economy of Steam Compression

Item No.		Formula	—Range of Pressure— Lbs. Gage 30–160	30–300
1	Quantity of steam, lb. per hour	Data	1,000	1,000
2	Quantity of steam, lb. per minute	No. 1/60	16.66	16.66
3	Spec. vol. at initial pressure, saturated, cu.ft.	Tables	9.39	9.39
4	Spec. vol. at final pressure, saturated, cu.ft.	Tables	2.602	1.500
5	Temperature at initial pressure, saturated deg. F.	Tables	274.5	274.5
6	Temperature at final pressure, saturated deg. F.	Tables	370.9	421.8
7	Total heat at initial pressure, saturated B.t.u.	Tables	1,171.6	1,171.6
8	Total heat at final pressure, saturated B.t.u.	Tables	1,195.9	1,204.7
9	Increase in total heat of saturated steam, B.t.u.	No. 8–No. 7	24.3	33.1
10	Volume of steam at initial pressure compressed per minute, cu.ft.	No. 2 x No. 3	156.4	156.4
11	Volumetric efficiency of compressor, per cent	Assumed	80	80
12	Required piston displacement, cu.ft. per minute	No. 10/No. 11	195.5	195.5
13	Cylinder diameter of single stage double acting compressor, inches	Assumed	10.0	10.0
14	Stroke of single stage, double acting compressor, inches	Assumed	10.0	10.0
15	R.p.m. of single stage, double acting compressor, inches	$\frac{\text{No. 12} \times 1{,}728}{0.7854(\text{No. 13})^2 \times 2(\text{No. 14})}$	215	215
16	Volume of 1 lb. steam at final pressure adiabatic compression, cu.ft.	$V_1\left(\frac{P_1}{P_2}\right)^{\frac{1}{1.31}}$	3.331	2.127
17	Ratio of compression	No. 3/No. 16	2.819	4.414
18	MEP, lb. per sq.in.	$\frac{P_2(1+\log_e R)}{R} - P_1$	81.5	132.3
19	I. hp.	$\frac{\text{Plan}}{33000}$	69.4	112.7
20	Mechanical efficiency of compressor, per cent	Assumed	85	85
21	Brake hp.	No. 19/No. 20	81.6	132.5
22	Final theoretical temperature, deg. F., adiabatic compression	$T_1\left(\frac{P_2}{P_1}\right)^{\frac{1.31-1}{1.31}}$	552.0	702.6
23	Theoretical superheat deg. F., adiabatic compression	No. 22–No. 6	181.1	280.8
23A	Theoretical superheat, deg. F., Mollier diagram	....	185.0	285.0
24	Loss of superheat by conduction and radiation, deg. F.	5 B.t.u. per sq.ft. per hour per 1 deg. F.	4.4	5.6
25	Actual superheat, deg. F.	No. 23–No. 24	176.7	275.2
26	Heat gained by steam in compressor, B.t.u. per minute	(No. 2 x No. 9) + No. 2 x No. 25 × Sp. Ht.	2,082.8	3,164.7
27	Electric power consumed by compressor motor driven, kw.	$\frac{\text{No. 21} \times 0.746}{0.85}$	71.6	116.3
28	Steam power consumed by compressor, steam driven, lb. per minute	$\frac{\text{No. 21} \times 40}{60 \times 0.85}$	64.1	103.9
29	Equivalent heat used by compressor, B.t.u. per minute	No. 21 x 42.43	3,462.3	5,622.0
30	Total efficiency, per cent	No. 26/No. 29	60.1	56.3
31	Cost of electric power per hour in dollars	No. 27 x 0.0075	0.537	0.87
32	Cost of electric maintenance per hour in dollars	No. 27 x 0.0125	0.895	1.454
33	Cost of incoming steam per hour in dollars	No. 1 x 0.0004	0.400	0.400
34	Cost of attendance per hour, motor driven, in dollars	Estimated	0.30	0.30
35	Operating cost per hour, motor drive not including maintenance nor fixed charges	No. 31 + No. 32 + No. 33 + No. 34	2.132	3.026
36	Cost of steam used for power per hour, steam drive, in dollars	No. 28 x 60 × 0.0004	1.538	2.495
37	Cost of attendance per hour, steam drive, in dollars	Estimated	0.40	0.40
38	Operating cost per hour, steam drive, not including maintenance nor fixed charges	No. 33 + No. 36 + No. 37	2.338	3.295
39	Cost of oil per hour, using boiler, in dollars	$\frac{\text{No. 1} \times \text{T. H.} \times 0.0173}{19{,}000 \times 0.65}$	1.636	1.648
40	Cost of attendance (special labor) per hour, boiler, in dollars	Estimated	0.75	0.75
41	Operating cost per hour, boiler, not including maintenance nor fixed charges	No. 39 + No. 40	2.386	2.398
42	Cost of apparatus, motor drive, in dollars	Cost curve	4,450.00	5,870.00
43	Cost of maintenance, motor drive, per year, in dollars	No. 42 x 10 per cent	445.00	587.00
44	Cost of depreciation, motor drive, per year, in dollars	No. 42 x 5 per cent	222.50	293.50
45	Cost of taxes, motor drive, per year, in dollars	No. 42 x ¾ per cent	33.40	44.10
46	Cost of insurance, motor drive, per year, in dollars	No. 42 x ¾ per cent	33.40	44.10
47	Cost of interest, motor drive, per year, in dollars	No. 42 x 8 per cent	356.00	470.00
48	Sum of maintenance and fixed charges on apparatus motor drive, per year	No. 43 + No. 44 + No. 45 No. 46 + No. 47	1,090.30	1,438.70
49	Cost of apparatus, steam drive, in dollars	Cost curve	4,010.00	5,380.00
50	Cost of maintenance, steam drive, in dollars, per year	No. 49 x 10 per cent	401.00	538.00
51	Cost of depreciation, steam drive, per year, in dollars	No. 49 x 5 per cent	200.50	269.00
52	Cost of taxes, steam drive, per year, in dollars	No. 49 x ¾ per cent	30.10	40.40
53	Cost of insurance, steam drive per year, in dollars	No. 49 x ¾ per cent	30.10	40.40
54	Cost of interest, steam drive, per year, in dollars	No. 49 x 8 per cent	321.00	430.00
55	Sum of maintenance and fixed charges on apparatus, steam drive, per year	No. 50 + No. 51 + No. 52 + No. 53 + No. 54	982.70	1,317.80
56	Cost of building and land, in dollars	$10.00 per sq.ft.	1,000.00	1,000.00
57	Cost of interest on building and land, per year, in dollars	No. 56 x 8 per cent	80.00	80.00
58	Cost of taxes on building and land per year, in dollars	No. 56 x ¾ per cent	7.50	7.50
59	Cost of insurance on building and land, per year, in dollars	No. 56 x ¾ per cent	7.50	7.50
60	Sum of building and land charges, per year, in dollars	No. 57 + No. 58 + No. 59	95.00	95.00
61	Total sum of maintenance and fixed charges, motor drive, per year	No. 48 + No. 60	1,185.30	1,533.70
62	Total sum of maintenance and fixed charges, motor drive, per hour	10 hours per day, 300 days per year	0.395	0.511
63	Total sum of maintenance and fixed charges, steam drive, per year	No. 55 + No. 60	1,077.70	1,412.80
64	Total sum of maintenance and fixed charges, steam drive, per hour	10 hours per day, 300 days per year	0.359	0.471
65	Total operating cost, exclusive of management, motor drive, per hour, in dollars	No. 35 + No. 62	2.527	3.537
66	Total operating cost, exclusive of management, steam drive, per hour, in dollars	No. 38 + No. 64	2.697	3.76

A Semi-Chemical Pulping Process

Investigations of the Forest Products Laboratory uncover a new outlet for mill waste in pulp

By J. D. Rue, S. D. Wells, F. G. Rawlings, J. A. Staidl
U. S. Forest Products Laboratory, Madison, Wis.

During the last five years, the Forest Products Laboratory has studied carefully the pulping of wood and the hydrolytic reactions incident to its decomposition [Rue, J. D., Studies in the Hydrolysis of Wood for Pulp. Presented at the Regional Meeting of the American Chemical Society, Madison, Wis., May 28-29, 1926]. Out of the study there has been developed a semi-chemical process by which the wood fibers are isolated in yields in excess of 70 per cent and in quality suitable for certain grades of board and for low and medium grades of print papers.

The idea of a semi-chemical method of pulping—a mild chemical treatment followed by mechanical disintegration—is not new. The literature abounds with such suggestions [see Rue, J. D., Semi-Cellulose and Semi-Chemical Pulping; A Review of Publications Relating to the Subject. *Paper Trade Journal,* Oct. 15, 1925], but, except as applied to steamed groundwood manufacture, none has come to important practical fruition.

The Process in Detail

Chemicals.—In the Forest Products Laboratory process, sodium sulphite forms a natural nucleus for the group of chemicals selected by reason of its ready solubility, its neutrality, its reducing properties, and the solubility of such compounds as are formed by its reaction with wood. Sodium bicarbonate is used with the sodium sulphite to maintain approximate neutrality of the reaction during digestion. The organic acids are neutralized with the liberation of carbon dioxide, which can be withdrawn as the digestion proceeds.

The proportion of the reagents to each other and to the wood is determined by the species and condition of the wood and by the quality of the product desired. The total quantity of chemicals need not exceed 15 lb. for each 100 lb. of wood. The quantity of bicarbonate must be sufficient at least to neutralize the organic acids produced. The bicarbonate may be replaced or supplemented by sodium carbonate or even by sodium hydroxide, provided the darker color of the pulp is not objectionable and provided also that modified properties of the product are desirable.

The cooking liquor may be prepared by absorbing sulphur dioxide in a solution of soda ash. The carbon dioxide liberated will be sufficient to convert the desired proportion of soda ash to bicarbonate.

Preparation of the Wood.—For pulp of the best quality and highest color the wood is barked, cleaned and chipped as for the sulphite process. For pulp of lower grade, such as is to be used in boards, the wood may be chipped in a "hog."

Impregnation of the Chips.—The chips are charged into a digester—preferably a globe rotary—and steamed for at least one-half hour at atmospheric pressure, and the digester is then filled with liquor which is forced into the chips under a pressure of about 100 lb. per sq.in. By a proper selection of the concentration of the liquor and the temperature of impregnation the requisite quantity of each chemical will be absorbed by the chips. At the end of the impregnation period, which may require approximately 1 hr., the liquor not absorbed by the chips is returned to the storage tank to be fortified for subsequent use.

Digestion of the Chips.—After the return of the excess impregnating liquor, the charge is brought quickly to a temperature between 140 deg. and 160 deg. C. and held there for a period varying from 1 to 6 hr. Rotation of the digester or else circulation of the liquor through an external pump is essential to uniform production. The digested chips are then dumped, and after being washed are ready to be fed to the rod mill. It should be emphasized that the higher the temperature and the longer it is maintained the more thoroughly will the chips be softened and the lower will be the yield. The properties of the product will also be determined in some degree by these factors.

Reducing the Softened Chips to Pulp.—The softened chips, which represent from 70 per cent to 85 per cent by weight of the wood, still have mechanical rigidity. The forces binding the fibers together have, however, been sufficiently weakened to permit the fibers to be rubbed or pounded apart without excessive injury. The separation of the fibers is advantageously accomplished by passing the softened chips through a rod mill. Sufficient water is fed with the chips to form a pulp suspension of between 4 and 8 per cent. The pulp which leaves the rod mill is like a chemical pulp and can be washed, screened and handled accordingly. The screenings are reground with subsequent charges of chips.

Application of the Process to Print Papers

For making white papers by the semi-chemical process, the wood must be light in color and relatively free from knots and other defects, and must be thoroughly barked and cleaned.

The coniferous species yield readily to the treatment, but the pulps thus far produced have not possessed strength and flexibility commensurate with the length of the fibers. Semi-chemical pulps from deciduous woods, however, possess strength and flexibility far in excess of the pulps prepared from the same woods by the soda process. Paper of the weight and caliper of news-

print made wholly from semi-chemical pulp of black gum, tupelo, or red gum, aspen, birch or maple, possesses greater strength than the present commercial newsprint. In the gums, provided black and red heartwood have been excluded, the color of the paper can be made by the use of dyes, equal to or better than standard newsprint. With the addition of clay an excellent catalog paper can be produced.

Semi-chemical pulp from aspen and birch, and possibly maple, can be substituted to the extent of over 50 per cent in the standard newsprint combination of groundwood and sulphite without sacrifice of quality. In fact, combinations of groundwood and semi-chemical pulp can be used without sulphite. The sheet which contains no sulphite possesses ample strength when dry, but is weak when it is wet and is found to require special care in the handling on the wet end of a paper machine.

Laboratory Tests.—In the semi-commercial tests made at the Forest Products Laboratory, wood was cooked in either 100-lb. or 500-lb. digesters and the softened chips ground in a rod mill 3 ft. in diameter and 5 ft. long, inside measure. The data for several typical cooking and paper strength tests made with three species of gum and with aspen, birch and maple appear in Table I at the bottom of the page.

Commercial Demonstration.—Fifteen cords of black gum was chipped and sent to a commercial plant specially equipped to carry on the semi-chemical process. The wood was cooked in a 14-ft. globe rotary digester, and the softened chips were ground in a rod mill 6 ft. in diameter by 12 ft. in length.

In a typical cook, 14.2 lb. of sodium sulphite and 2.4 lb. of sodium bicarbonate (calculated as sodium carbonate) were used for each 100 lb. of wood. The chips after impregnation were cooked for 4 hr. at a temperature ranging between 155 deg. and 160 deg. C. The chips were milled at the rate of 9.3 tons per 24 hr. with a power consumption of 90 hp., or at the rate of 9.7 hp.-days per ton. The pulp was partially dried on a board machine, and the rolls were shipped to a paper mill. The yield was approximately 75 per cent, oven-dry.

At the paper mill, portions of the pulp were beaten and without the addition of other fiber were made into paper on a "Yankee" machine at the rate of 90 ft. per min. The strength of the sheet is indicated by the following data for sheet No. 5A:

Weight per ream, 24x36x500	48.1 lb.
Caliper	0.0042 in.
Mullen test	24.5
Points per pound per ream	0.51
Breaking length	4,510 meters
Stretch	1.14 per cent
Tear	40.0 gm.
Double folds	18

Estimated Cost of One Ton of Pulp.—The cost can be estimated with accuracy only for a given locality and with due regard to local unit cost. The following rough estimate is based upon a plant capacity of 100 tons daily production:

Wood—0.954 cords of gum, birch, or maple, peeled, at $10 per cord	$9.54
It is estimated that 1 cord = 3,000 lb. oven-dry wood = 2,100 lb. oven-dry pulp, the oven-dry yield being taken as 70 per cent.	
Soda Ash—358 lb. at $1.50 per 100 lb.	5.37
Sulphur—72 lb. at $1 per 100 lb.	0.72
(Chemical consumption based upon use of maximum quantities, viz., 4 lb. sodium bicarbonate, calculated as carbonate, and 10 lb. sodium sulphite.)	
Power—Rod mill, 12 hp.-days; chipping and miscellaneous, 3 hp.-days; total, 15 hp.-days at 24c.	3.60
Steam—2,000 lb. at 50c. per 1,000 lb.	1.00
Labor—0.4 man-day per ton, at $4 per man-day	1.60
Maintenance	1.00
Overhead—15.7 per cent (basis, $8,000 per ton daily capacity or $26.67 per ton annual capacity)	4.19
Total cost of 1 ton slush pulp	$27.02

When a wood of relatively low density, such as aspen, is used, consideration must be given to an increase in the number of cords required and to a corresponding increase in the cost of wood.

Application in the Manufacture of Boards

In the manufacture of semi-chemical pulp for boards, the selection and preparation of the wood does not demand the care demanded in the manufacture of print papers. As in the latter, however, semi-chemical pulps from the broadleaf woods are preferable to those from coniferous species for reasons already stated. Mill and logging waste can be used when it is economical to do so. "Hogging" may replace chipping. Inasmuch as a light-colored product is not a prime essential, such dark-colored woods as chestnut, oak, elm, and the red heartwood of gum may be used, although light-colored woods need not be excluded.

Laboratory Tests.—In board tests made at the Forest

Table I—Cooking Data for Hardwood Pulps Designed for Print Papers, and Strength of Paper Made

	Cooking Data								Strength of Machine Made Paper			
		Chemical Used per 100-Lb. Oven-Dry Wood										
Cook No.	Maximum Temperature Impregnation, Degrees Centigrade	Na_2SO_3 Pounds	$NaHCO_3$ Calculated as Na_2CO_3 Pounds	Maximum Cooking Temperature, Degrees Centigrade	Time to Maximum Temperature After Impregnation, Hours	Time at Maximum Temperature, Hours	Digester Gage Pressure, Pounds per Sq.In.	Yield Oven-Dry Basis, Per Cent	Weight per Ream 24x36x500, Pounds	Bursting Strength (Mullen), Points	Strength Factor, (a)	Folding Endurance, Number Double Folds
Aspen												
2175	129	9.8	4.9	140	0.4	2.0	50 to 60	83(*b*)	38.0	21.7	0.57	104
2176	127	11.3	4.7	160	0.6	2.0	82 to 107	74	51.0	30.4	0.60	305
2182	125	15.1	5.8	156	0.3	3.0	75	..	37.0(*c*)	21.0(*c*)	0.57(*c*)	38(*c*)
Black Gum												
2055	100	6.5	...	160	2.0	2.0	....	70(*d*)	....	....	....	...
2057	100	8.0	1.6 $NaHSO_3$	160	2.0	0.0	....	86	....	....	....	...
2082	100	10.4	2.3	160	2.1	2.0	81 to 96	79	40.5(*e*)	11.3( )	0.28(*e*)	4(*e*)
2181-N	128	9.0	3.6	160	0.3	3.0	70 to 90	..	45.5	17.8	0.39	15
White Birch												
2177-N	125	7.3	3.2	140	0.5	2.0	51 to 60	80	51.0	47.5	0.93	115
2178	125	8.1	4.9	160	0.6	2.0	85 to 98	81	43.5	38.2	0.88	253
2183-N	126	6.1	4.0	158	0.3	3.0	79 to 86	..	36.0	24.8	0.69	161
Maple												
2179	128	9.1	4.4	145	0.3	2.0	55 to 65	85	75.0	34.6	0.46	13
2184	126	11.1	4.6	160	0.3	2.0	90 to 110	80	....	....	....	...

(*a*) Bursting strength divided by weight per ream.
(*b*) Pulp shivey.
(*c*) Paper contains 25 per cent groundwood.
(*d*) Chips burned.
(*e*) Beater furnish contained 20 lb. mineral filler and 6 lb. alum per 100 lb. fiber.

Table II —Cooking Data for Hardwood Pulps Designed for Boards, and Strength of Paper Made

Cook No.	Cooking Data: Maximum Temperature Impregnation, Degrees Centigrade	Cooking Data: Chemical Used per 100-Lb. Oven-Dry Wood: Na_2SO_3 Pounds	Cooking Data: Chemical Used per 100-Lb. Oven-Dry Wood: $NaHCO_3$ Calculated as Na_2CO_3 Pounds	Cooking Data: Maximum Cooking Temperature, Degrees Centigrade	Cooking Data: Time to Maximum Temperature After Impregnation, Hours	Cooking Data: Time at Maximum Temperature, Hours	Cooking Data: Digester Gage Pressure, Pounds per Sq.In.	Yield Oven-Dry Basis, Per Cent	Strength of Machine Made Paper: Weight per Ream 24x36x500, Pounds	Strength of Machine Made Paper: Bursting Strength (Mullen), Points	Strength of Machine Made Paper: Bursting Strength Factor, (a)
Chestnut											
2048	100	8.3	...	161	1.8	2.0	83 to 95	81	52.9	27.6	0.52
2113	110	2.8	4.4	129	0.4	1.0	....	89	117.0	31.4	0.27
2112	114	4.4	6.7	133	0.4	2.0	....	79	125.5	48.3	0.38
Cottonwood Mill Waste											
2119	120	11.5	8.4	155	0.5	2.0	45 to 65	..	108.3	92.8	0.86
Gum Mill Waste											
2120	122	10.4	4.1	150	0.3	1.5	50 to 54	..	120.8	85.5	0.71

Products Laboratory, the previously described equipment was used. Chestnut chips from which the tannin had been extracted, cottonwood mill waste, and gum mill waste were reduced to semi-chemical pulp and made into light-weight board on the Laboratory's 15-in. Fourdrinier machine. The cooking data and the strength data for the boards appear in Table II.

The production of board from extracted chestnut chips by the semi-chemical process has passed into the commercial stage of manufacture. More than 1,000 tons of the new product have been satisfactorily marketed.

The chips are cooked in a 14-ft. globe rotary digester with 4 lb. of sodium bicarbonate (calculated as carbonate) and 8 lb. of sodium sulphite at a temperature of 150 deg. to 160 deg. C. The pulp is ground in a rod mill 6 ft. in diameter and 12 ft. in length rotating at 14 r.p.m. The capacity of the mill is about 12 to 15 tons per 24 hr., depending upon the degree of hydration desired and less than 90 hp. is required to operate it. The pulp is passed through a Jordan to the cylinder machine and made into board 0.009 in. thick. The sheet gives a Mullen test of about 0.5 point per pound per ream. It possesses unusual strength, stiffness, and toughness for the short fibers used in its manufacture.

The sheet has been used successfully for corrugating. Boxes made with chestnut corrugated board have been demonstrated by laboratory test and by actual service in transportation to be fully equal to boxes made with straw corrugated board.

Efforts to find a use for hardwood mill and logging waste in the standard pulping processes have not been successful. The fibers of the hardwood are too short to yield a strong pulp even by the sulphate process and cannot compete with sulphate fiber made from coniferous woods. Soda pulp, which is practically the only kind made from hardwoods, must be clean and easily bleached. Well cleaned and thoroughly barked round wood is more conducive to cleanliness of pulp than either mill or logging waste. Moreover, a supply of round wood is available for soda mills, adequate to meet their limited demands. Thus mill and logging wastes have remained a drug on the market as far as standard pulping requirements are concerned.

The quantity of waste from a single mill is as a rule not large. The large capital cost of a modern chemical pulp mill precludes the small local plant. On the other hand, the low value of waste material does not warrant high freight charges to large centers. The semi-chemical process, however, through its low capital cost (about half that of chemical processes), the feasibility of operating it in small units, and the low cost of its product, may prove a valuable aid in converting hardwood waste into valuable board products. To what extent semi-chemical pulp can economically and technically supplement the present ingredients of container and other grades of board has not been fully determined, despite the success already attained with chestnut board; but the possibilities are sufficiently great to warrant further investigation.

Estimated Cost of Semi-Chemical Pulp for Boards.—The estimate of the cost of pulp for print papers, previously presented, applies to pulp for boards except that there may be some reduction, due chiefly to the lower cost of wood and of its preparation.

Coniferous Woods in the Semi-Chemical Process.—Reference has already been made to the low strength of coniferous pulps prepared by the semi-chemical process. Some typical data bearing out this point, obtained at the Forest Products Laboratory in a study of the process as applied to jack pine, loblolly pine, and tamarack, appear in Table III. The pulps obtained thus far are brash and of poor felting quality, but they bulk well, and it may be possible to use them in certain types of insulating board. Better felting qualities and improved flexibility and consequently greater strength are obtained with digesting liquor of higher alkalinity. No great improvement in these qualities is obtained, however, without marked sacrifice of yield.

This paper was made possible by the generous cooperation of the Southern Extract Co., the Chicago Mill and Lumber Co., and the Carolina Fiber Co.

Table III —Cooking Data for Coniferous Pulps, and Strength of Paper Made

Cook No.	Cooking Data: Maximum Temperature of Impregnation, Degrees Centigrade	Cooking Data: Chemical Used per 100 Lb. Oven-Dry Wood: Na_2SO_3 Pounds	Cooking Data: Chemical Used per 100 Lb. Oven-Dry Wood: $NaHCO_3$ Calculated as Na_2CO_3 Pounds	Cooking Data: Chemical Used per 100 Lb. Oven-Dry Wood: Na_2CO_3 Pounds	Cooking Data: Chemical Used per 100 Lb. Oven-Dry Wood: NaOH Pounds	Cooking Data: Maximum Cooking Temperature, Degrees Centigrade	Cooking Data: Time to Maximum Temperature After Impregnation, Hours	Cooking Data: Time at Maximum Temperature, Hours	Yield Oven-Dry Basis, Per Cent	Strength of Machine Made Paper: Weight per Ream 24x36x500, Pounds	Strength of Machine Made Paper: Bursting Strength (Mullen), Points	Strength of Machine Made Paper: Strength Factor, (a)	Strength of Machine Made Paper: Folding Endurance, Number Double Folds
Jack Pine													
2019	...	15.1	...	...	6.1	162	0.5	3.5	69	51.0	21.4	0.42	140
2020	...	15.1	...	5.8	...	162	0.5	3.5	67	42.5	23.3	0.55	68
2021–2	...	14.7	3.2	...	...	162	0.5	3.5	74	47.0	14.6	0.31	15
2016	...	15.4	...	...	...	161	0.5	3.5	81	51.0	13.9	0.27	6
2022–1	...	16.4	4.8($NaHSO_3$)	...	...	161	0.5	3.5	84	88.0	13.3	0.15	1
2094	134	6.8	...	...	7.1	161	0.8	2.8	68	109.9(*f*)	48.0(*f*)	0.44(*f*)	80(*f*)
Loblolly Pine													
Project 7168–1J20 2	...	10.0	...	...	2.0	160 to 162	1.0	3.0	69	....	....	....	...
Tamarack													
Project 7168–3J19 10	103	20.5	...	...	...	160 to 168	1.0	4.0	Not determined	....	....	....	...

(*f*) Hand sheets beaten 60 min. in pebble mill.

Recent Chemical Progress in Industrial Fields

Editorial Staff Report

EDITOR'S NOTE. At the meeting of the American Chemical Society held in Detroit during the week of September 5, chemical engineering interest centered principally in the sessions dealing with the industries related to the automotive field. Thus the rubber, petroleum and other divisions of the Society focussed their attention on recent chemical contributions to the automobile industry. Editorial staff reports of some of these sessions and others of interest to the chemical engineering industries follow.

Reclaimed Rubber Proves a Stabilizer

Rubber Division of A. C. S. holds "Reclaim" Symposium and hears miscellaneous papers on aging of rubber

ONE of the notable chemical engineering achievements of the rubber industry is the production and improvement of reclaimed rubber in quantity and quality to be a factor in maintaining supplies and limiting prices. In the judgment of William C. Geer, this service in 1926 alone saved rubber users of the United States over $55,000,000; and it promises to serve as a stabilizer of the rubber market indefinitely. Because of these economic considerations there was more than the usual interest in the papers presented before the symposium on reclaimed rubber at the meetings of the Rubber Division during the American Chemical Society Convention at Detroit.

Pigment Reinforcement. The reinforcing action of pigments on reclaimed rubber was discussed by H. A. Winkelmann and E. G. Croakman, who have studied carbon blacks, zinc oxides, clays, barytes, whiting, and a variety of other constituents in their effect upon compounds. They conclude that the order of effectiveness of the pigments is practically the same in compounds containing reclaim as in those including only new crude rubber; but they report that there is a wider gap in the series between those pigments which have reinforcing value and those which are non-reinforcing in character. The general impression gained from their work was that carbon blacks were distinctly the best in this characteristic and that other pigments were of negligible or poor value.

Vulcanizing Reclaim. R. E. Cartlidge and H. L. Synder have investigated the influence of varying quantities of sulphur for vulcanizing compounds containing reclaim. To study the effect of the percentage of reclaim in the compound, vulcanizing tests were made with various mixtures containing from 5 per cent to 60 per cent of the rubber in this form and the balance as new crude rubber. Varying quantities of sulphur were used. The quantity of sulphur used was figured as 4 per cent of the new rubber plus varying percentages of the reclaim. It was concluded that between 2½ and 3 per cent of the weight of reclaim was the proper allowance for sulphur for this part of the compound. In the discussion of this conclusion it was pointed out, however, that the percentage of hydrocarbon in reclaim is such that an allowance of 2½ to 3 per cent of sulphur on total weight of reclaim is equivalent to practically 4 or 5 per cent of sulphur on its hydrocarbon content.

Value of Reclaim. A series of tire tread stocks containing varying amounts of reclaim were compounded by W. W. Vogt in such a manner that the ultimate composition of all stocks was the same, the only variable being the percentage of hydrocarbon from the reclaim which was substituted for the hydrocarbon from new rubber. The cures used on these various compounds were varied to give what appeared to be the technical optimum condition in the same time of cure. Tensile and abrasion tests by five different methods were carried out on the cured stocks as a measure of the usefulness of the hydrocarbon obtained from the reclaim. The authors conclude that—"the value of the reclaim rubber hydrocarbon varies from zero, when substituted in small percentages, up to a maximum of 50 per cent of the value of new rubber when compounded in large percentages."

Speed of Cure. Data presented by N. A. Shepard, H. F. Palmer, and George W. Miller emphasized the generally known fact that reclaimed rubber vulcanizes at a more rapid rate than new rubber hydrocarbon. These data also confirmed the fact that even small concentrations of reclaim in new stock materially speeds up the rate of cure of the entire mixture.

Chemical Engineering in Reclaiming. P. S. Shoaff, chemical engineer in the Goodyear company, presented a general review of the technology of reclaiming rubber compounds. He pointed out that the production of a uniformly good product depends first upon proper classification and blending of the raw materials. The grinding should produce uniformly small particles (but an excess of very fine material must be avoided) in order that devulcanizing time may be a minimum at the permissible temperatures, that the tendency to depolymerize may be minimized and that the requirement for softeners be reduced. The desired plasticity and processing characteristics during compounding, milling, calendering, etc., are best obtained when such devulcanizing conditions are maintained. Among the other conclusions expressed were the following. "Devulcanization at high temperatures tends to reduce slightly the tensile and to increase the elongation as compared with treatment at lower

temperatures. Alkali reclaims require efficient washing to remove residual caustic and the recovery of fines from the wash liquors involves problems of settling and filtration or screening. Drying of wet-processed reclaims at high temperatures or for an excessively long time results in tacky products just as does over-devulcanization. A minimum amount of milling and refining at normal temperatures is desirable to preserve the quality; therefore previous processing should be thorough and uniform."

Aging Effects. Aging tread compounds containing low concentrations of iron, copper, manganese, and mercury salts of aliphatic organic acids was reported by W. N. Jones and B. S. Taylor. From tests in a Bierer-Davis bomb it is concluded that the presence of the copper and manganese salts, even in very small concentrations, is harmful. Jones and Winkelmann reported on similar work with reference to the action of amphoteric metallic salts in rubber compounds. Using certain of these materials, isomers of rubber have been made by heat treatment which show greater heat plasticity and less chemical unsaturation than the rubber itself.

W. N. Jones and a group of associates in the Goodrich company investigated effects of stretching on the aging of rubber. It is concluded that vulcanized rubber under stress ages more rapidly than unstressed rubber. The rate of deterioration is not proportional to the degree of stretch in the early stages of exposure to sunlight; but there appears to be a critical elongation for each stock at which deterioration progresses most rapidly. These same conclusions apply to aging in ozonized oxygen, in which atmosphere the cracking of rubber can be greatly accelerated by stretching. Exposure to such atmosphere for 18 hours did not produce material change in tensile strength if the rubber was unstressed, but even a very small amount of stretching produced rapid cracking.

Heating crude rubber at 158 deg. C. under pressure produces a hydrolysis and a material change in properties. An increase in rate of cure in some cases and a slowing up in others occurs, depending on the type of rubber and the accelerators used for curing. This work, by Park, Carson, and Sebrell, indicates that the stress-strain curve assumes a different shape on heated rubber and that there has been a change in the nitrogen distribution and an increase in the acid number of the hydrocarbon. The effect of heating upon aging is apparently negligible.

Methanol and Hydrocarbons from Water Gas

Reactions of water-gas constituents in synthesis and in combustion discussed by Gas Division

SYNTHESIS of hydrocarbons and alcohols from water-gas constituents was considered in three papers presented before the industrial gas symposium. The formation of methane from water gas was investigated by Prof. A. H. White and F. W. Hightower of the University of Michigan working in the range from 300 to 400 deg. C. in the presence of nickel catalysts. In the first series of tests 110 passes of the gas over a nickel catalyst at 350 deg. C. indicated that all three of the following reactions took place in about the percentage indicated:

$$CO + 3H_2 = CH_4 + H_2O \quad \text{16 per cent}$$
$$CO_2 + 4H_2 = CH_4 + 2H_2O \quad \text{8 per cent}$$
$$2CO = C + CO_2 \quad \text{28 per cent}$$

Judged by the composition of the end products formed the following reaction did not take place appreciably:

$$2CO + 2H_2 = CH_4 + CO_2$$

The second series of tests, involving a single slow pass of the gas over the catalyst showed that practically all of the change occurred according to the first reaction given above. In the work done the largest conversion obtained was the change of 75 per cent of the carbon present to methane. In general it was concluded that any carbon and hydrogen containing gases would react under the conditions investigated to produce some methane. The best conversion temperature with the catalysts used was apparently 350 deg. C. The proportion of the end products formed from the reaction is largely affected by the concentration of the water present in the original reacting gases.

J. D. Davis and his associates of the Bureau of Mines reported investigations on the formation of liquid hydrocarbons from water gas and particularly their studies to determine the most desirable form of catalyst. Their best oil yields were obtained with a catalyst containing cobalt, manganese oxide, and small quantities of a copper promoter, working at 275 deg. C. It was notable that the conversion obtained was very greatly increased by a reduction in rate of flow of the gas mixture over the catalyst. In one series six times the percentage yield was obtained by using half the maximum speed. These investigators have estimated that if water gas cost 20 cents per thousand cu.ft. it would be possible with the best conditions that their work developed to make gasoline at 37 cents per gallon without assuming credits for sale of butane and methane formed. If the butane could be marketed at reasonable prices the gasoline would cost 23 cents per gallon and if the methane also could be sold the net cost of the gasoline would be 19 cents per gallon, according to their estimates.

A third series of investigations was reported by R. L. Brown and A. E. Galloway, who were working to obtain synthetic methanol. Their first investigations were carried out at a temperature of 400 deg. C. under a pressure of 200 atmospheres and the gas was circulated with continuous make-up to original volume over three types of catalysts—zinc oxide, basic zinc chromate, and normal zinc chromate. For these particular samples of catalyst the yields varied from practically nothing to about 750 grams per hour per liter of catalyst used. The oxide was not as effective as either of the promoted chromates.

Tests were also carried out by allowing the pressure to drop from 270 to 100 atmospheres in a closed circulating system with no gas make-up, working at temperatures of 300 deg., 350 deg., and 400 deg. C. The advantage of high pressure under these conditions was clearly demonstrated. In practically all of the work done there was very little oil formed with the methanol; at high temperatures the percentage of water in the product was greater; under certain conditions a 95 per cent methanol was obtained.

Based upon these results it was estimated by one commentator that if water gas was 25 cents per thousand cu.ft. and the by-product gas made could be sold at 20 cents per thousand cu.ft. for fuel, the cost of the methanol

would be 30 to 31 cents per gallon. This estimate of cost included all capital charges (on the assumption that the investment would be same per ton of daily capacity as that required for a synthetic ammonia plant); but did not include selling expense or profit.

Carbonization Investigations Reported

Coking of fine coal, low-temperature tars, and wood distillation considered at Detroit sessions

CARBONIZATION of powdered coal has been studied on a semi-works scale by Prof. D. J. Demorest as a result of work done in the full-scale U.G.I. vertical retort which is installed at the experiment station of Ohio State University. This work is the extension of the small-scale investigations by Prof. A. H. White of Michigan. He proposed partially to carbonize coal by dropping 10-mesh material through a vertical retort and removing the products as fast as formed.

Work was carried on at about 500 to 2,000 lb. per hr. in the retort at approximately 2,200 deg. F. wall temperature with coal through 10-mesh but on 14-mesh screen. Pocahontas coal gave only approximately 2,000 ft. of gas per ton and the solid product was little changed in appearance from the original coal. Evidently this low-volatile coal is not suited to the process. The second coal used was Hocking Valley Ohio No. 6 coal which yielded about 5,500 cu.ft. of 650 B.t.u. gas, approximately 170 lb. of tar, and an unagglomerated coke containing 18 to 20 per cent residual volatile matter. The ammonia yield was small, from one-quarter to one-third that obtained during complete carbonization. An Eagle seam West Virginia gas coal gave similar yields, but a little more gas, reaching about 6,000 cu.ft. per ton. A Zeigler, Illinois coal gave about the same tar and the same gas yield as the Ohio coal, but the heating value of the gas was lower, about 600 B.t.u. per cu.ft.

The principal operating difficulty experienced was that the coal would build up a shelf around the retort wall and bridge over in the retort preventing the free fall of the incoming material. After a few hours' operation it was necessary, therefore, to bar down or otherwise scurf the retort. It was estimated that such a retort could be operated commercially at about 1,000 lb. of coal per hour, which is nearly five times the commercial through-put with complete coking. The coke could be used either for briquetting or as a powdered fuel for boiler firing. If so used with a power plant it is estimated that a 100-kw. electric station would be equivalent in its requirement to approximately 10 million cu.ft. of rich gas per day or equivalent to a 600-ton open-hearth steel plant in its fuel demands.

The author estimated that one should not assume yields greater than 5,000 cu.ft. of 700 B.t.u. gas, 150 lb. of tar, and 2 lb. of ammonia; the gas would probably have the high heating value indicated largely because nearly 50 per cent greater quantity of unsaturated hydrocarbon is found than is usual with oven gas.

A differential index of the coking power of coal was discussed by T. E. Layng and A. W. Coffman, of the University of Illinois. These authors propose a graphical means for determining the index number for a coal called the "agglutinating index." The magnitude of this index indicates the manner in which "coking energy" and "agglutinating power" is distributed between the constituents of the coal; it is affected largely by the extent to which the coal has been weathered. The authors in general conclude that "The agglutinating power of a coal is a function of (1) the rate of heating to which it has been subjected, (2) the conditioning to which it has been subjected, (3) the weathering through which it has passed, and (4) the chemical interactions taking place during plasticity."

THE composition of tar formed from Utah coal by low-temperature carbonization with super-heated steam at about 700 deg. C. has been investigated by R. L. Brown and B. F. Branting. Chemical characteristics of this tar are summarized by these investigators in the following conclusion:

That portion of the tar soluble in the aqueous condensate contained in grams per liter, the following: Carboxylic acids, 0.39; phenols, 2.25; bases, pyridines, 0.0824; ammonia 0.3966; neutral oil, 0.1. The phenols consisted of carbolic acid about 33 per cent, cresols 18 per cent (mainly para and meta but with some ortho present), catechol 4 per cent; higher phenols, 4 per cent; tar acid resins, 37 per cent. The liquid tar examined was about 29 per cent of the total tar and it contained, (a) insoluble solids 1.0 per cent; (b) carboxylic acids, 0.25 per cent; (c) crude bases 1.7 per cent; (d) phenols (1) soluble in ether 21.0 per cent and (2) insoluble resin 2.4 per cent; (e) neutral oils 66 per cent; (f) water plus working loss 7.65 per cent. The bases were 60 per cent distillable, and these contained little if any pyridine but were rich in dimethyl pyridine and higher homologues. Of the crude phenols 30 per cent were solid and non-distillable bodies, 50 per cent were distillable and the remainder was made up of contaminations—ether, water, oils, wax and fractionation and other working losses. The distillable phenols were divided by fractionation as follows: phenols 6 parts, ortho cresol 7, para and meta cresols 19.5, xylenol fractions 36.5, and higher homologues 31.0 parts. There was identified, phenol, ortho-, meta- and para-cresols, 1-2-4 xylenol, 1-3-5 xylenol and catechol isolated above.

Of the neutral oil, 8 per cent distilled up to 140 deg. and 65 per cent between 140 and 275 deg. Of the remainder, about one-half distilled with steam. This distillate yielded wax equal to 2 per cent of the neutral oil and 10 per cent of a heavy oil-wax mixture with a viscosity of 225 Saybolt seconds (at 100 deg. F). The residue contained wax, oil, and resin, equal to about 7, 3, and 5 per cent, respectively, of the neutral oil.

Wood and cellulose, both alone and impregnated with a catalyst have been destructively distilled under pressure in various gaseous atmospheres by P. K. Frolich, H. B. Spalding, and T. S. Bacon. These investigators summarize the important conclusions reached in their work as follows:

Pressure alone favors the formation of methanol as evidenced by a doubling of the methanol yield under a hydrogen pressure of 3,000 lb. per sq. inch. The autogenous pressure of the gases evolved in the distillation has a similar effect. With the catalysts studied the yield of methanol is usually decreased at atmospheric pressure and barely improved when higher pressure is employed. Check experiments on cellulose demonstrate that the increased methanol yield is derived from the methoxyl groups and not from the cellulose molecule. With nickel as a catalyst and hydrogen under 3,000 lb. per sq. inch, cellulose is almost completely converted into gaseous and liquid products, the latter consisting of phenols and saturated and unsaturated hydrocarbons. When nitrogen is substituted for hydrogen the cellulose is volatilized to practically the same extent. Whether this process of decomposition of cellulose and wood to form phenols and hydrocarbons will meet with commercial success, would seem to depend to a large extent on the development of suitable equipment for continuous operation.

Recovering Waste Heat From Coke by Dry Quenching

THE METHOD of recovering waste heat by the dry quenching of coke, developed by Sulzer Brothers Company, Winterthur, Switzerland, was described in *Chem. & Met.*, Vol. 31, No. 15, pp. 574-575. Since that time a plant to operate by this process has been erected at the Rochester Gas & Electric Company, Rochester, N. Y., and has been successfully operated for about one year. Recently, it has been announced that the International Combustion Engineering Corporation has acquired the American rights to this process.

The plant at Rochester consists of two units, each comprising a coke container, a waste heat boiler and the circulating fans. A single skip hoist serves both units. Each container holds about 40 tons of coke. The operation of these containers is continuous, the coke entering at the top from an automatically revolving chute, the cooled coke being drawn off through an air-tight discharge at the bottom, and inert gas being circulated from the bottom of the container up through the hot coke. The gases leaving the top of the container are circulated through the waste heat boiler and hence back through the coke.

Gas entering the boilers varies in temperature from 800 to 1,200 deg. F. and leaves at temperatures from 300 to 850 deg. F.

The boilers are of the horizontal fire-tube type with 2½ in. tubes, 18 ft. long.

This installation handles 530 tons of coke per day and, on the average produces 439 lb. of steam at 139 lb. gage per 1,000 lb. of coke quenched.

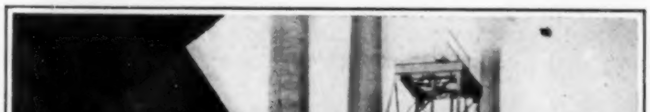


Fig. 1—Installation of Dry Coke Quenchers and Waste Heat Boilers at Rochester Gas & Electric Company

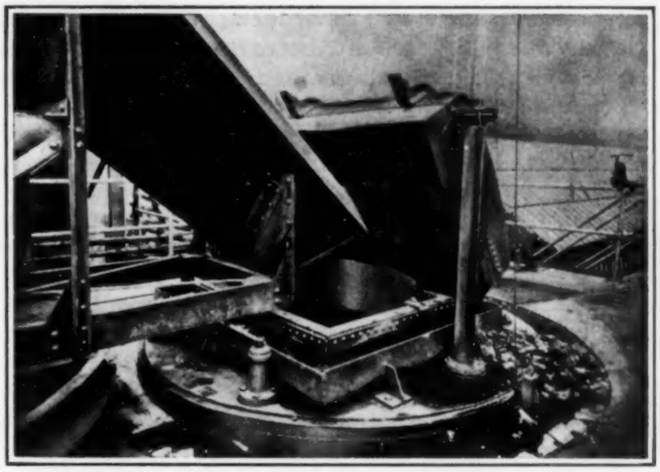


Fig. 2—Chute Discharging Hot Coke Into Container

Tests of Fusion Process of Low Temperature Carbonization

By C. H. S. Tupholme
London, England

THE "Fusion" process of low temperature carbonization was described in outline by the present author in *Chem. & Met.* Vol. 29, No. 17, October 22, 1923. A plant has been installed at the works of the Electro-Bleach & Byproducts, Ltd., at Cledford in Cheshire, and this plant was recently subjected to an official test by the Director of Fuel Research of the Department of Scientific and Industrial Research, Dr. C. H. Lander, a report subsequently being issued.

From the writer's previous article it will be seen that the "Fusion" plant is one of the class in which the material is turned over during carbonization, tending to produce large oil yields, but apt to produce only a comparatively small proportion of the solid residue in the form of lump coke. The actual unit tested was designed as a test plant, so that it could be used on as wide a range of bituminous material as possible, and also be used for experimental work on certain chemical processes. For these reasons, and for ease in obtaining accurate measurements, no attempt was made to provide the most economical equipment for handling the raw material and the products, as the accessories required for this would vary greatly according to the material that was treated.

The coal selected for the test was a cannel coal containing over 46 per cent volatile matter, and giving in the assay apparatus considerably more than twice the yield of tar to be expected from an ordinary bituminous coal.

Heating of the retort is carried out by the sensible heat of the gases from a coke-fired furnace, the furnace being built into the brickwork near the discharge end of the retort. The fuel used for the purpose of the test was blast furnace coke, since this can be obtained of uniform quality.

As a wide range of materials has been used for test purposes, no attempt has been made to heat this retort by means of the spent material, as this material necessarily varies greatly in quality according to the raw material used. The gases from the furnace pass first into a mixing chamber, the parts subjected to the highest tem-

perature being composed of high-class fire brick. From this chamber they pass to the retort chamber through ports, and by the adjustment of these any desired temperature gradient can be obtained. Baffles are fixed to the top of the retort chamber and ensure that the heating gases circulate round the retort. The waste gases make their exit by a flue situated near the charging end of the retort. Five thermocouples are located at different points in the retort chamber on the side remote from the furnace, the ends of the couples almost touching the retort. A sixth couple is fixed in the waste gas flue.

The coal used was first crushed to a size not exceeding ½ in. and ⅘ lb. was removed for every 112 lb. crushed, and a proximate (as charged) analysis of this average sample was as follows:

	Per Cent
Moisture	1.8
Volatile matter, less moisture	46.6
Fixed carbon	36.8
Ash	14.8
	100.0

The ultimate analysis was (dry coal):

	Per Cent
Ash	15.00
Carbon	70.20
Hydrogen	6.32
Sulphur (total)	0.78
Nitrogen	1.50
Difference (oxygen and errors)	6.20
	100.0

The calorific value of the coal was 12,970 B.t.u. per lb.

The sampling of the residue was not begun until 1½ tons of material had been discharged, to allow of the entire removal of the spent material added in the first instance. The amount removed as a sample was 4 per cent of the total weight discharged. The analysis of the carbonized residue was as follows:

	Per Cent
Volatile matter (in nitrogen)	9.7
Fixed carbon	64.8
Ash	25.5
	100.00

The calorific value was 10,850 B.t.u. as discharged. The determination of the volatile matter was carried out in nitrogen at 925 deg. C. One cwt. of the residue was sent to H. M. Fuel Research Station, and sieving tests were carried out with the following results:

On ½-in. sieve	0.4
Through ½ in. on ¼ in.	5.2
Through ¼ in. on ⅛ in.	14.2
Through ⅛ in. on 1/16 in.	20.0
Through 1/16 in.	60.2

The volume of scrubbed gas made during the test was 31,800 cu.ft. at 60 deg. F. and 30 in. pressure. The average calorific value of the gas was 1,070 B.t.u. per cu.ft. Analyses of the average samples of gas are given in Table I.

Table II—Tar Yields

	Gal. (dry)	Specific Gravity at 15° C.	Gal. (dry) per Ton of Coal	Calorific Value B.t.u. per Lb. Dry	Sulphur Per Cent
Crude spirit from the gas	43.50	0.740	3.75	19,870	0.47
Tar:—					
Light	17.76	0.815	1.53	19,120	1.40
Medium	418.40	0.943	36.10	18,430	0.58
Heavy (from hood seal, dust catcher and separating tanks)	102.70	0.983	8.85	17,740	0.52

The average analysis of the unscrubbed gas was:

CO_2	6.5
Unsaturated hydrocarbons	13.2
O_2	1.0
CO	6.4
H_2	17.1
C_nH_{2n+2}	49.5
N_2	6.3

Estimated calorific value, 1305 B.t.u. per cu.ft. gross.
Scrubbed gas calorific value, 1110 B.t.u. per cu.ft. gross.

The crude spirit collected was weighed and the water contained in it separated.

Crude spirit collected (cont. 16% wash oil) = 4.51 gal. per ton of coal.
Crude spirit to 200 deg. C., $D\,\frac{15}{15}$ = 0.740 = 3.75 gal. per ton of coal.

The yields of tars, together with their calorific values and sulphur contents, were as shown in Table II.

The heavy tar was distilled to 270 deg. C. and the tar acids in this fraction were also determined. The amount obtained was 1.13 per cent by volume or 0.10 gal. per ton of coal.

In large scale test at H. M. Fuel Research Station a weight balance of a test is usually made, and a test is considered to be satisfactory only when a satisfactory balance is obtained. The following weight balance was prepared in connection with this test:

		Tons
Coal		11.60
Water added to coal		0.38
Water to seals		0.61
		12.59
		Tons
Residue		6.79
Spirit from gas	0.14	
Light tar	0.06	
Medium	1.77	
Heavy	0.46	
		2.43
Gas		0.95
Liquor		1.78
Residue, dust and tar removed from hood, etc.		0.55
		12.50

The temperature did not exceed 620 deg. C. at any position in the report chamber making the process true low temperature carbonization.

Table I—Gas Analyses

Successive periods of samples from beginning of test, hrs.	1.75	6	6.1	5.4	5.6	7.5	3.2	8.2	6.75	5.5	6.0	5.4	6.4	2.75
CO_2, etc.	No. Sample	3.6	4.2	5.0	4.6	Lost	5.8	5.9	5.8	6.7	7.0	6.6	7.9	7.0
Unsaturated hydrocarbons		10.8	11.8	12.6	11.4		11.0	10.1	10.5	11.5	10.7	10.1	10.6	11.5
O_2		0.9	0.3	0.3	0.5		0.5	0.7	0.8	1.5	0.2	0.5	0.4	1.3
CO		3.6	4.2	1.6	3.5		4.1	6.4	4.2	5.4	2.6	2.2	3.2	10.5
H_2		12.8	16.8	16.2	8.9		16.7	14.0	14.5	15.8	16.6	15.4	16.2	11.1
*C_nH_{2n+2}		37.1	47.6	58.0	51.2		46.7	46.6	51.7	47.5	54.0	53.0	51.1	43.6
N_2		31.2	15.1	6.3	19.9		15.2	16.3	12.5	11.6	8.9	12.2	10.6	15.0
		100.0	100.0	100.0	100.0		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
* "n"		1.52	1.45	1.44	1.41		1.57	1.51	1.50	1.42	1.58	1.51	1.52	1.45

Chemical Warfare and the United States Navy

By E. W. Brown

Commander (M. C.), U. S. Navy, Edgewood Arsenal

EDITOR'S NOTE: *On Navy Day, October 27, 1927, we are to be reminded as a nation of our dependence on the United States Navy in its important rôle in the national defense. But scant attention has been given, however, to the Navy's interest in chemical warfare and for that reason we have asked Commander Brown to write on this subject from his viewpoint as chief of biochemical research at Edgewood Arsenal.*

WHEN we consider that the use of chemicals became an established method of warfare by land forces during the World War, the question naturally arises: Why was chemical warfare not employed by the navies in that conflict? Two considerations were apparently responsible; one, that the navies of the contending forces did not desire to be responsible for the initiation of poison-gas warfare at sea; the other, that both sides had grave doubts as to the value of chemical agents as compared to the older methods. The effects of a direct hit by a shell, a torpedo, or a bomb loaded with high explosive were known. The results to be expected from the use of chemical agents at sea were uncertain and the replacement of arms of proved value in favor of new and untried methods was not considered justified.

The success of gas warfare in the World War, the ready commercial availability of chemical intermediates for the production of poison gases and the danger of such surprise attacks in war have, however, led the principal powers to accept the advent of chemical warfare and to incorporate it into the scheme of national defense for both sea and land forces.

Accepting chemical warfare, the question naturally arises: By what methods could it be carried on at sea? Poison gas can be dropped from aircraft by direct spraying or sprinkling, or in gas bombs, either of the floating or low explosive type. It can be projected into the interior of ships in shell; it can be dispersed from the stacks of destroyers as such, or mixed with screening smoke; it can be dropped from the stern of a retreating fleet to evade pursuit; it can be strewn in the path of an attacking enemy by using floating containers set off by a time fuse. In fact, a surprise attack with chemical agents skillfully maneuvered and well followed up might well result in the complete defeat of an enemy fleet; especially if some new chemical agent were employed or if any of the old agents were projected in some newer or more effective manner.

The Edgewood Arsenal is the center for the research, production and training activities of the Chemical Warfare Service of the U. S. Army. Since 1922, a Naval Unit has been established there to maintain a close liaison with the U. S. Army authorities. Certain bureaus of the Navy Department have allotted funds from year to year to Edgewood Arsenal and a systematic combined Army and Navy research, development and production program has been in progress. Officers and enlisted men of the Navy are assigned from time to time to the Chemical Warfare School at Edgewood Arsenal for courses of instruction in Chemical Warfare.

The types of chemical agents adopted by the Chemical Warfare Service of the Army are divided into four general groups as follows:

1. Lung irritants: Chlorine, phosgene and chloropicrin.
2. Vesicants: Mustard and Lewisite.
3. Lachrymators: Chloracetophenone and brombenzylcyanide.
4. Toxic smokes: Diphenylchlorarsine and diphenylaminechlorarsine.

Only certain of these gases would be suitable for naval application. Lung irritants would probably not be suitable, as most of them are non-persistent and would be quickly dissipated. Their use would probably be of little effect as compared with high-explosive shell. On the other hand, vesicants promise to be of great value but would probably not be used during an actual naval engagement because of their delayed action. However, they have great possibilities if delivered 8 to 12 hours in advance of such an engagement.

Lachrymators of the persistent type promise to be of value during a fleet action because of their blinding effect, because they would cause the enemy to mask and harrass him seriously during combat. The toxic smokes are undoubtedly of great promise if a successful and safe method of projection can be developed. Not only is the effect immediate, as with tear gases, but the settling of dust clouds on decks and bulkheads has the effect of making these agents persistent, requiring masking until removal.

From this brief discussion it will be seen that plans for future naval engagements must consider the threat from mustard, lachrymators and toxic smokes. Of these the threat from mustard is the most serious and the most difficult of defense.

In chemical warfare, as in other forms of combat, the surprise effect is outstanding. This may be accomplished in two directions, i.e. (1) by the development of new chemical agents and (2) by new or more effective methods of technique for the projection of such chemical agents at sea. An immediate vesicant is the type of gas best adapted to meet the requirements.

Such problems as the following are under consideration: the spraying or sprinkling of chemical agents from aircraft; the dropping of gas bombs either of the burning and floating, or low explosive type from aircraft; the dispersion of gases from destroyer stacks; projection of gas in high explosive shells. Problems of smoke screen production are of allied interest.

Research along these lines is also of great value from the defensive standpoint, as there is less likelihood of an enemy using a gas unknown to us and against which we have no protection.

NAVAL gas defense is conveniently considered from the viewpoints of (1) collective defense or protection and (2) individual defense or protection. The vital concern of collective defense is to keep gas out of the interior of ships. This means the developing and providing of installations to prevent the entrance and dissemination of gases in the various compartments of naval vessels. This problem offers many difficulties. The gas protection of the individual, as is true with the Army, is effected by the gas mask and protective clothing.

Substantial progress in the study of all phases of the protective work and of the prophylaxis and treatment of gas casualties has been accomplished by the research activities of Edgewood Arsenal.

Dangers from Static Electricity in Handling Solvents

By Arthur A. Backhaus

Production Manager, U. S. Industrial Alcohol Co., Baltimore, Maryland

EDITOR'S NOTE. *This article and the one by Mr. Nixon, which follows it, are abstracts of two papers presented before the Chemical Section of the National Safety Council at the sixteenth annual Safety Congress held at the Stevens Hotel in Chicago, September 26-30, 1927.*

FIRES and explosions constitute the dangers from static electricity in the handling of solvents. Only those substances which are flammable and which have vapor pressure characteristics to produce explosive mixtures with air are dangerous. Many solvents used in industry are flammable and produce vapors which form explosive mixtures with air, consequently, static is a possible source of danger in handling solvents. In general, static may develop in the handling of solvents as follows:

1—Liquid solvent flowing through pipes or tubing.

2—Liquid solvent passing through a gaseous medium (e.g., air).

3—Solvent vapor issuing from an opening into a gaseous medium (e.g., air).

4—Gas passing through liquid solvent.

The list of conditions thus enumerated is small. However, practically all handling of solvents comes within the range of these operations. From the fact that static fires have been confined to relatively few solvents, it must be concluded that dangerous static arises only under certain limited conditions. If it were possible to define accurately these conditions, it would not be difficult to prescribe preventives.

Handling solvents through pipe lines or tubing is universal practice. What danger, if any, is involved?

It is a well-known fact that when some liquids flow rapidly through small pipes electric potential will develop. Dolezalek (*Zeitschrift Chem. Ind.* 35, 166, 1912), and later, Holde *Berichte d. Deut. Chem. Ges.* 47, 3239, 1914), and others, have demonstrated experimentally that electrical charges will develop in this way. Using gasoline and petroleum ether potentials of 50 to 2,200 volts were obtained by Holde, in copper tubing 2.5 mm. diameter and 95 cm. (about 3 ft.) long. According to Bruno Muller (*Chemiker Zeit.* Feb. 1, 1923, p. 97-98) a potential of at least 300 volts is required to give a spark strong enough to ignite gasoline.

Assuming that a potential of 300 volts is required to ignite the ordinary solvents used in industry (carbon bisulphide with its very low ignition temperature would undoubtedly ignite more easily), the question as to whether a particular solvent is likely to develop dangerous static while flowing through pipe lines must be related to its electrical conductivity.

To avoid static fires in dry cleaning plants in Germany, M. M. Richter recommended the use of magnesium oleate. It is stated that a concentration of 1/20 per cent of this soap is sufficient to prevent dangerous static in washing wool in gasoline. The soap increases the electrical conductivity sufficiently so that the charge will "drain off." Specific conductance of the gasoline soap solution is of the order 1×10^{-10}.

Bruninghaus (*Recherches et Inventions*—Vol. 7, 735, 1926) has shown that under certain conditions the presence of metal powder will render gasoline non-electric. He concludes that the substance which causes static inactivity is a substance which increases conductivity.

In view of the importance of electrical conductivity in this study a search was made to find specific conductance data for the common solvents. Unfortunately, data were found for only a few. These are shown in Table I.

Table I—Specific Conductivity of Commonly Used Solvents (In reciprocal ohms)

Gasoline[1]	2×10^{-12} (15°C)
Benzol[2]	2.5×10^{-13}
Methyl Alcohol[3]	0.2×10^{-6}
Ethyl Alcohol[4]	0.103×10^{-6} at 25°S
Propyl Alcohol (N)[5]	2×10^{-8}
Iso Amyl Alcohol[6]	1.5×10^{-8}
Acetone[7]	0.321×10^{-6} (25°C)
Ethyl Ether[8]	1×10^{-9} or smaller
Water[9]	0.9×10^{-6} at 18°C

[1](*Chem. Zeit.* 148 (1911) p. 1375)
[2](Holde, *Ber.* 47 (1914) p. 3239)
[3](Jones & Lindsey, *Z. Phys. Ch.* 56 p. 129)
[4](Walden, *Z. Phys. Ch.* 54 (1906) p. 128-130)
[5](Keyes & Winninghoff, *J. A. C. S.* 38 (1916) p. 1178)
[6](Keyes & Winninghoff, *J. A. C. S.* 38 (1916) p. 1178)
[7](Walden, *Z. Phys Ch.* 54 (1906) p. 128-130)
[8](Holde, *Ber.* 47 (1914) p. 3239)
[9](Kendall, *J. A. C. S.* 38 (1916) p. 2460)

An examination of the table shows that many solvents are fairly good conductors. Such solvents when flowing through pipe lines are safe statically. With liquids whose specific conductivity is low, dangerous accumulations of static may be avoided by using pipe lines which are good conductors and well grounded.

What has been said thus far applies to the handling of solvents in liquid form and confined in pipe lines. Under this condition there is little danger from static with conducting solvents.

REAL danger starts where the pipe line ends. Here the fireworks may begin. If the line ends in the air and the stream of liquid falls, a new condition is encountered. Under these conditions high static potentials may develop with any liquid, even water. Possibilities of static from this cause are very thoroughly covered in a paper given by Naylor and Ramsey before the petroleum section of the National Safety Council in 1923. There is no simple grounding method of taking care of and rendering harmless static produced by liquid spray. The simple safety measure in this case is to avoid static by avoiding the spray, which can be done by discharging the liquid at the bottom of the receiving vessel or tank.

If conditions are such that liquid spray cannot be avoided, the only safety measure is to condition the air, so that the electric charges on the droplets will dissipate themselves. Ionizing the air for example with ultra violet light or X-rays, or humidifying the air will render such static harmless.

There seems to be uncertainty as to what is a safe relative humidity. In Wm. D. Milne's very interesting paper on "Fire Hazards in Churns and Spreader Rooms," read before the Rubber Section at the Twelfth Safety Congress, a relative humidity of 40 to 45 per cent is said to give a "safe" atmosphere. The exact relation between humidity and static dangers seems not to have been covered experimentally. It is the intention of the author to investigate this question.

The third general method encountered in handling solvents covers solvents in vapor phase, i.e., in gaseous forms. Some very interesting work has been done in connection with the study of static produced by gases. The use of hydrogen gas in air navigation involves dangers and accidents from static ignition of hydrogen gas.

The steam jet, utilized in the old Armstrong hydroelectric machine, will develop static of high voltage. The invisible portion of the jet at the opening from which the steam issues is not charged. It is only after condensation takes place that static charges develop, presumably due to friction of the droplets through the gaseous medium.

There are many anhydrous liquids which will not generate dangerous static flowing through pipes; likewise, gases in motion through the air will not develop static unless solid or liquid particles are present.

Very little practical information is available covering the fourth condition listed at the beginning of this paper. The use of air for agitation is a common practice in chemical industry. Air is extensively used for agitating alcohol to render the contents of a tank uniform. To my knowledge, no accident has ever resulted from this practice, due probably to the fact that alcohol is, relatively speaking, a good conductor. It is doubteful if this practice is a safe one in the case of solvents having low conductivity. A scientific investigation of this problem would be helpful.

Safety from the Viewpoint of the Plant Manager

By A. B. Nixon

Superintendent, Hercules Powder Co., Parlin, New Jersey

ALL of the factors and problems which enter into any business are necessarily subservient to the basic purpose of the business. Now one and then another may be more important and may seem to be temporarily in need of stressing but we find them all linked together, each depending upon the other. Safety must always bear a relative position to the other problems and likewise the consideration of all factors must of necessity give a consideration to safety.

Most plants of progressive industrial establishments are fairly well equipped with mechanical safeguards. No plant is perfect in this respect. We all have room to advance in this direction. Those with the older plants are probably farther from the ideal since in the construction of a new plant many details of design looking toward ultimate safety can be economically provided while often the history and experience in the risk is not such as to warrant the cost of a change in existing equipment.

Yet with all of these mechanical safeguards our industrial accidents go on. Sometimes I am inclined to believe that the multiplicity of mechanical safeguards has led us to believe that our plants are foolproof. There is nothing so dangerous as a "foolproof" guard. Our real safety job is, first, to lay out our plant in such a way as to make operations reasonably safe and then to realize ourselves and bring home to the men those hazards that still remain.

The real development of safety standards has only started when mechanical guards are provided. The real approach to safety has to do largely with the development of a safety sense on the part of the foreman and individual workman. A danger to be avoided is a general impression that safety considerations are the province only of the safety committees or safety engineer. These are only a means to an end. They are merely tools looking toward the ultimate education of the workman.

Many methods are in use, looking toward the propagation of the safety sense among the workers. All of them are valuable in the right place and they all have their advantages and I need not take the time to illustrate these various methods of approach. No matter what system you use or how good it is, it can be seriously handicapped, if not completely spoiled, by a single faulty regulation.

As a nation we must have laws in order that we may conduct ourselves individually and collectively in a manner which promises to be best for the common good. Likewise in industrial establishments we must have certain rules to guide our actions. We must have some sort of a system in order that we may get the most effective use of the energy which is applied to the particular work we have to do.

We are loud in our criticism of our law makers for the volume of prohibitory laws which they turn out each year. But how many of us give sufficient heed to the volume of prohibitory rules that may be given out in our own establishments each year?

Certain rules and regulations which formulate an operating system are necessary. These for the most part should be rules for doing things and not against doing them. They should be kept to a minimum consistent with uniform practice.

ANY proposed rule should be thought carefully through before issued. It should be known in advance that it could be consistently followed; that the equipment permitted and that it would never be secondary to production. Any rule that gives way to production requirements is worse than no rule at all.

Such care in the formulation of regulations breeds confidence and the men will know that you understand what you say. Then, if you are careful to see that no slight violation passes unnoticed they will understand that you mean what you say.

A few good general safety rules, energetically enforced, mean more to the development of a sense of safety than a multitude of detailed instructions. Once this sense of safety is developed, the individual will think of more detailed safety measures for his own particular problem than you could ever formulate for him.

We are frequently asked to evaluate the result of certain changes in procedure, certain safety campaign policies or what not. We find plenty of published records showing the wonderful achievement obtained as the result of certain particular efforts, let it be wage payment plan, safety campaign, plans for the prevention of losses or what not. We find a surprising similarity in the result achieved by all substantial establishments, no matter what particular problem seems to motivate the dominant study. In general, I feel that it is impossible to evaluate accurately the contribution of any one of these factors to the general progress that has been made. No matter where we start, before any real progress has been made all factors have to be touched and all contribute to the result, and there is grave danger ahead for any of us who attempt to make any one of these factors appear as the dominant cause.

Your business may be large enough to warrant a special power division, a safety division, a production division, or a general purchasing department, but nevertheless the success of the whole business and the separate divisions of the organization and the individuals who make up this organization will be proportional to the degree that each subordinates itself or himself to the general purposes of the enterprise.

Chemical Manufacture in TEXAS

Will Follow the Development of Consuming Industries

By W. T. Read

Head, Department of Chemistry, Texas Technological College, Lubbock, Texas

THAT Texas is not a great manufacturing state merely means that this stage of development is just now being reached. The value of manufactured products in Texas has increased about 1,000 per cent in the past twenty years. Texas produces 7.5 per cent of the crop value of the nation, 7 per cent of the raw material of all sorts, and has 4.4 per cent of the population. On the basis of value added by manufacture, Texas' share of the nation's industries is only 1.3 per cent. This shows the great possibilities of the future.

The growth of chemical industries depends obviously on the growth of industries which are consumers of chemicals. Manufacturing in Texas does not wait upon resources, both agricultural and mineral, for the state has these in lavish abundance. Texas has intelligent, native, American labor. Texas has fuel in unlimited quantities. Texas has a vast system of railroads and great ports. Agriculture and the production of raw materials in general have almost completely overshadowed manufacturing.

The development of manufacturing industries in Texas depends largely on two factors—first, the attitude of local capital, and second, the supply of trained technical men who can plan, supervise, and develop industries. Texas capital is becoming "industrially minded." There is ample capital in the state to make great industries possible, and these will in turn attract capital from outside the state. Texas business men are inclined to be cautious and conservative. They do not want a boom, but a steady, sound growth on a permanent foundation. They prefer to depend less on boosting and more on substantial advice from financiers, economists, engineers, geologists, and chemists.

The state is preparing to train her own technical men to a high degree of skill and knowledge. There are already two large and well-equipped engineering schools in state owned institutions, one at the State University and the other at the Texas Agricultural and Mechanical College. There are several private institutions making progress along this line. Within the last two years a new state school known as the Texas Technological College has been founded at a cost of around $2,000,000, and has set a record in enrolling over 1,000 students the first year and 1,500 its second. At this institution the Department of Textile Engineering has a building and equipment valued at $250,000, and nearly $600,000 has been appropriated for buildings and equipment for engineering and the sciences. There is a definite advantage in having Texas men with the major part of their training in Texas institutions in charge of Texas industries. They command on the one hand the respect and confidence of investors, and they have an understanding of the labor which they have to handle.

AS YET Texas has relatively few chemists, but their number is increasing. Outside of teachers of chemistry, most of them are in the petroleum refineries. Twenty years ago the chemists at the packing houses received their standard solutions from their Chicago laboratories. About that time the chemist for one of the few cotton-seed oil refineries of the state marvelled greatly over the process of hydrogenation, and particularly over what he called the "Kate Eliza." This is all changing rapidly. Every year graduate students from Texas institutions go to the greatest universities and technical schools in the nation for final training in chemistry and chemical engineering. The Graduate School of the University of Texas is being built up very rapidly. Several capable firms of consulting chemists and engineers are well established in the state. Industries are turning more and more to chemical engineering for advice and guidance.

This gives in a very general way the situation in Texas. The state is enormously rich in land, minerals, and forests. The population is increasing rapidly. Capital is turning to manufacturing. The educational institutions are preparing to train technical men. There are ample transportation facilities. Fuel is abundant and labor is not lacking. Every indication points to a growth in manufacturing commensurate with the diversity and the immensity of this state that is in itself an empire.

In a recent letter, Stuart McGregor, editor of the *Texas Almanac,* an accurate and valuable industrial publication of the *Dallas News,* writes: "Recently I have covered about 2,500 miles visiting many industrial plants. In each instance I asked the superintendent about the use of chemicals, but there is little. * * * I have noticed that when I bring up the subject of the future of chemistry in Texas industry, the chemist dismisses the present manufacturing industries rather briefly, and then goes into future possibilities on the basis of what Texas has to offer in its natural resources."

WITH definite facts and figures in hand, chemical engineers and executives can determine for themselves what the future of chemical industry will be.

The United States Census for 1923 shows the following figures for Texas manufacturing:

Number of establishments	3,693
Wage earners	102,358
Primary horsepower	548,299
Wages	$111,641,494
Value of products	979,192,057
Value added by manufacture	331,740,823

Industries with products valued at over $10,000,000 are listed below:

	Product Valuation in Millions of Dollars
Petroleum refining	344.0
Lumber and planing mill products	62.1
Cotton-seed oil and cake	60.4
Slaughtering and meat packing	58.8
Cars and steam railway construction	47.0
Flour and grist mill products	40.0
Automobiles (assembling)	39.2
Printing	34.0
Foundry and machine shop products	25.0
Bread and bakery products	18.8
Cotton goods	17.6
Food preparations (not otherwise specified)	16.1
Wood preserving	14.4
Ice	12.7
Rice (cleaning and polishing)	10.6

The value of chemicals produced in Texas is given as less than $1,500,000. There are growing industries which still lack something of reaching the ten million dollar mark. For example, Texas has six portland cement mills. Glass sand and natural gas have been responsible for glass industries in at least three sections of the state. A considerable part of the paving and building brick used in the state are made in Texas kilns.

It will be noted that the cotton-seed oil industry ranks third in the state. This is at present largely a mechanical process. Most towns over the state have cotton-seed oil mills which delint and crush the seed, cook the meats, and press out the oil, selling the crude oil, the hulls, and the cake or meal. There are very few refineries putting out finished cooking and salad oil or semi-solid shortening. There is a growing tendency among crushers to plan for putting the crude oil through at least the first stage of refining.

One of the potentially great industries of Texas is the textile industry. At present there are only about 275,000 spindles and 6,000 looms, consuming not more than one fortieth of the Texas cotton crop. Practically none of the wool and mohair of Texas are spun into yarn or fabrics. Texas capital and Texas educators are showing great interest in the textile industry.

It has often been said that most of the mineral wealth of Texas is pumped out of the ground in pipes. Artesian and mineral waters, brine, sulphur, natural gas (a part of which contains helium), and petroleum are the leading mineral products. Petroleum statistics for 1926 show that Texas was credited with 165,647,610 bbl. out of a total of 768,663,940 in the United States. A majority of the larger cities and towns of the state are supplied with natural gas. Texas does not possess coking coals and for this reason the enormous iron ore deposits in eastern Texas will wait a long time for development.

In 1926 the sulphur deposits of Texas yielded one and half million tons of this commodity. Stratified salt deposits of great thickness underlie a considerable part of the state, and there are great salt domes along the coastal plain and in east Texas. Limestone for building, burning, and cement making is abundant and widely distributed. Cement, brick and pottery clays, and also kaolin are found in quantity in Texas, and the quality and usefulness of these ceramic materials are being investigated by the Bureau of Economic Geology of the University of Texas. To this active and valuable branch of the University may also be credited the first scientific investigation of the potash resources of the state, as well as the collection of most of the accurate information as to Texas mineral resources. Widely distributed potash indications make the situation most hopeful. Six mills are making building material from Texas gypsum. There is an impressive variety of other materials which are at present of less commercial importance. A great deal of exploration still remains to be done in determining and evaluating Texas mineral resources.

Texas depends mainly for her prosperity on what comes from the soil. It is estimated that sixty billion board feet of lumber have been cut from Texas forests since 1870. The present average annual production is around one and a half billion board feet, mainly pine. The present timber stand is around 17 billion board feet of pine and 8 billion board feet of hardwood. There is relatively little reforestation. Texas has produced some turpentine and rosin. Only a few mills are making paper from pine wood, and there is little utilization of waste.

Texas leads in beef cattle, in sheep and goats, in production of wool and mohair, and is second in total value of all livestock. The production of beef, veal, pork, and mutton amounted in 1925 to over one billion pounds. Texas people consume nearly twice as much pork as they produce, but have a surplus of other meats of about 70 per cent of the total production. Mild climate, long growing seasons, and the possibility of producing a great variety of feed stuffs, all favor the continued growth of the livestock industry.

THE first impression of Texas gained from a glance at the map of the United States is that of size. A more thorough study of the state will add the idea of diversity of climate, elevation, and soil. This diversity makes possible an infinite variety of agricultural enterprises. The chief crop of Texas is cotton. It is estimated that half of the population of Texas depends for its living on cotton and cotton industries. Yet Texas receives comparatively little of the wealth added to the cotton crop by manufacture. Probably as many people outside of the state are dependent on Texas cotton for a living as there are inhabitants of the state. In 1926 Texas ginners reported 5,630,831 bales, and it was estimated that 270,000 bales remained unpicked in the fields. On the basis of a 500-lb. bale, the crop was valued at $354,000,000. A very interesting development on the

South Plains of Texas is the gathering of cotton by the "sledding" process, which obviates expensive picking. Special cleaning machinery prevents the grade from being materially lowered. Cotton seed from the crop of 1926 amounted to 2,800,000 tons and was valued at $52,600,000. Cotton is regarded by economists as the most valuable asset of the state, and also as its greatest threat and greatest problem.

The average value of all Texas crops is estimated at $829,000,000 and the acreage at 26,657,000. Aside from cotton most of these are feed crops, corn, grain sorghums, oats, and hay.

With these extensive agricultural operations, Texas still uses comparatively little fertilizer. The total annual sales are about 135,000 tons, mainly on cotton lands. It should be noted that Texas can easily double the acreage of tillable land. There is very little intensive cultivation except in the truck growing regions. Extensive irrigation projects are still largely in the future. Scientific agricultural methods and the wide use of fertilizer will add tremendously to productivity. Texas is after all primarily an agricultural state, and industries will be built largely on the raw materials produced from the soil, supplemented by minerals which are converted into chemicals and used in such manufacture.

RESULTS of core drilling for potash in Texas were reported by A. P. Schoch and H. E. Sellards in a recent paper presented before the American Chemical Society at Detroit. This work, done by the Standard Potash Company in the southwestern section of Midland County, Texas, indicates, according to these authors, occurrences of potash salts covering an area approximately 3 by 6 miles at a depth of about 2,000 ft. A 5-ft. bed of almost pure polyhalite was cored at 2,075 to 2,080 ft. in the first well drilled. The second well, three miles farther west is reported to show an 11-ft, layer containing about 60 per cent of soluble salt having 9 to 10 per cent K_2O content between 1,980 and 1,991 ft., and a second 3-ft. layer of polyhalite between 2,172 and 2,175 ft. This latter layer corresponds to the 5-ft. bed in the first well. In further drilling of the second well another 3-ft. layer of polyhalite and a 2-ft. layer were penetrated, together with a bed of 170 ft. of salt containing a high percentage of polyhalite, before drilling stopped at a depth of 2,611 ft. Estimates of these investigators are that approximately 23,000,000 tons of K_2O occurs in this area as polyhalite and that there is 34,000,000 tons of other soluble potash.

The work reported by Professor Schoch has not yet led to commercial projects, but at the present time engineering estimates are being prepared as to the cost of sinking a shaft, the probable costs of mining, and the best available methods for separation of the potash from the associated salts. Financing of further work awaits the completion of these estimates.

HYDRO-ELECTRIC power developments are not immediate possibilities in Texas. The question of power is largely one of fuel and boiler feed water. Petroleum is a widely used fuel, both as crude and as distillate. The wide use of natural gas has already been discussed. Bituminous coal of fair grade (12,000 B.t.u.) in seams averaging around 2 ft. in thickness is found under some 25,000 square miles. Texas lignite deposits are estimated at thirty billion tons. These are found under 60,000 square miles and extend over a territory 200 miles long and 100 miles wide, extending from East to South Central Texas. Much of this lignite can be exposed by removing the overburden of soil with steam shovels. The lignite varies greatly in structure, quality, and analysis, but it is estimated as having an average of 25 per cent to 35 per cent moisture and a heat value of 7,500 to 8,000 B.t.u. "as received." Extensive investigations on the processing of Texas lignites are being carried on at the University of Texas. The example of the Texas Power and Light Company, however, is apt to be extensively followed. A 53,000-hp. plant, capable of expansion to 215,000 hp., uses powdered lignite for raising steam.

Much of Texas water is heavily mineralized. Deep artesian waters are fairly soft. The larger part of the water supply will yield to treatment with zeolite or lime-soda. Water in the lignite region is for the most part quite soft and low in solids.

Texas has a relatively small foreign population. Native white Americans make intelligent and capable factory hands. With their farm background, they will continue to live on the land rather than in the cities, grow their own food, and come to the factories over good roads in automobiles. Those industries that can fit their labor demands to the crop seasons will be most fortunately situated. With a mild climate and the ability to grow all needed food, living costs are particularly favorable.

By 1928 Texas will have 16,750 miles of railroads. The distribution is good, and several transcontinental systems are represented. Texas has several good seaports, the leading one of these being Galveston. A ship channel brings many vessels inland to Houston, a distance of 50 miles. Texas is second only to New York on the basis of value of exports, the difference last year being about $110,000,000. The next state in this respect has less than half the value of exports accredited to Texas.

The fact that the state has 4.4 per cent of the nation's population and only 1.3 per cent of value added by manufacture answers the question of local markets for manufactured goods. Most of the raw materials are of such a nature that extensive manufacturing operations are necessary, and in relatively few of them iron and steel enter as components. While such products as portland cement, brick, and lime are limited in their markets by shipping costs, there is a vast number of products made from Texas raw materials which will find a nation-wide market in competition with goods fabricated in other parts of the United States.

THUS the future of manufacturing in Texas, and particularly of the chemical industry, can be weighed, measured, and predicted with considerable accuracy by any one thoroughly familiar with chemical engineering economics. A state that grows a third of the nation's cotton and clips a large part of the nation's wool and mohair and spins and bleaches and dyes very little of it; a state that produces a large share of American vegetable oils and refines only a small part of them; a state that has clays, limestones, glass sand, gypsum, salt, and sulphur; a state that has unlimited petroleum and natural gas resources, vast beds of lignite, to say nothing of the best of labor, ample transportation, fine harbors, growing markets, and a thrifty and progressive population ready to back industry with money and technically trained leaders is bound to have an important future in chemical industry.

Opportunities in FLORIDA *for Industrial Growth and Development*

By Andrew M. Fairlie
Consulting Chemical Engineer, Atlanta, Georgia

AFTER the debacle in Florida real estate prices during the winter of 1925-26, perhaps some temerity is required in one who ventures to say a good word for the State. Such temerity was evident, however, as early as the spring of 1926, when a group of prominent Florida men met at Palm Beach in a convention known as the "Florida Takes Inventory Congress," held under the auspices of the Florida State Chamber of Commerce.

This congress was held, after the collapse of the facilities of the railway, steamship and express companies, and even of the United States Post Office, under the strain of Florida traffic, and after gambling on margin in Florida real estate had ceased. It was held in order to take stock of what Florida had at that time of material resources, as compared with what it had a year before. It was held, too, to take stock of the State's liabilities. This congress was the result of a conviction that the gold-rush was over, and that the future success of Floridans lay in hard work, in production, in development of the State's resources, and in service to fellow-men.

The liabilities were summed up as consisting chiefly in the existence in the State and out of it, of a number of people who wanted to take much money out of the State without putting anything in, and in the fact that faith in Florida had been impaired, all of which may be attributed to the folly of over-extolling the virtues and values that Florida possessed. Florida herself was found to be her chief asset.

The lack of complete and reliable data concerning the industrial and agricultural resources was admitted by the Congress, and the State agricultural department was authorized to conduct an industrial survey of the State, and this is expected to be completed in June, 1928. Until the results of this survey are available, it is necessary to be content with such fragmentary information as can be gleaned here and there.

Florida, with an area of 58,666 square miles, is the second largest state east of the Mississippi River. She has 3,751 miles of coast—more than any other two states of the Union. She has 30,000 lakes, varying in size from one acre in area to the second largest lake within the borders of the United States. The northwestern part of the State is a rolling, hilly country, and in the central part of the State there is a ridge which separates the streams of the east coast from those of the west. The highest elevation is about 300 feet. The State census of 1925 gave Florida a population of 1,300,000. The density of population was about 22 per square mile, as compared with 420 per square mile for New Jersey and 566 per square mile for Rhode Island. The total assessed value of property in the State was $177,000,000 in 1910, and $550,000,000 in 1925. The real value of the property in the State in 1925 was $6,000,000,000. Florida is the only State free from bonded indebtedness. The levying of income or inheritance taxes is prohibited by the State constitution.

As an illustration of the under-development of Florida's industries, it may be stated that the State purchases annually $125,000,000 worth of food. Of the money thus spent, $38,000,000 is for meat and meat products, $24,000,000 is for dairy products, and $12,000,000 is for poultry and poultry products. On the other hand the combined value of all the meat, dairy and poultry products produced in the State is only $29,000,000. The proportion of manufactured goods imported, as compared with those made at home, is likewise unbalanced, and the figures constitute an invitation to the establishment of home industries.

Jacksonville, the chief industrial center of the State, had 434 factories in 1926, distributed among 137 business classifications, with an aggregate value of output amounting to $100,000,000 per year. These figures are cited to show that the requirements for the successful conduct of industry—reasonable freight rates, transportation facilities, raw materials, skilled and unskilled labor, low power rates, banking accommodations and markets—are met in Florida, and that industrial activity in large volume is already there. Jacksonville, due south of Cleveland, Ohio (400 miles west of New York), is the most westerly port on the Atlantic seaboard. The commerce of the world can enter the port of Jacksonville, and in 1925 her exports amounted in value to $12,000,000, as compared with imports to the value of $9,500,000.

It may have seemed irrelevant to cite here statistics relating to agricultural products; yet the agricultural and

horticultural pursuits of Florida make opportunities for the successful establishment of numerous industrial enterprises. For example, the canning and preserving industry in Florida is capable of great expansion. In addition to the common fruits and vegetables, Florida grows many edible products peculiar to the State, and seldom found in Northern markets, such as the avocado, the mango, the guava and the papaya. These could profitably be canned, preserved or manufactured into jellies, etc., and such Florida delicacies, as rare in the North and West today as the grapefruit was thirty years ago, could be marketed throughout the Union as fast as the production could be increased. Three canneries in 1925 produced nearly 200,000 cases of canned grapefruit, and many orders remained unfilled. This product is ideal for use in salads and in special desserts, and provides an ideal citrus fruit, with all the health-giving qualities retained, twelve months in the year.

The possibilities for the development of new marketable products are numerous. One concern has recently developed a citrus juice concentrate which can be bottled or canned, with all the flavor and qualities of the fruit retained. Sold in this form, it can enter the boundless field of the soft-drink industry, and, it seems, would have no difficulty in displacing much of the volume of business now enjoyed by the synthetic imitations of fruit juices, which lack vitamins, genuine flavor and natural color. Low-temperature and low-pressure evaporation or spray drying of fruit juices should be able to produce a complete line of fruit-juice concentrates, or even of powdered fruit-juices.

The Chamber of Commerce of Jacksonville states that opportunities exist in the Jacksonville district for the following industries: woodworking plants, furniture factories, textile mills, pulp mills, paper box and cooperage factories, soap factories, oil refineries and food-product plants.

Lumber and Naval Stores.—Of the established industries in Florida, the principal one is the production of lumber and naval stores. In 1923, Florida produced 1,100,000,000 board feet of lumber, valued at $45,000,000. The present wooded area of the State amounts to 22,000,000 acres, containing 36,000,000,000 board feet of merchantable standing timber.

Florida has about 35 per cent of the establishments of the country for the production of naval stores. It is estimated that the value of the Florida crop of turpentine and rosin in the year 1923-4 was about $12,000,000. The total value of the lumber and naval stores industries of Florida, then, is close to $60,000,000 a year. If Florida is to retain her present position in these industries, a prompt, vigorous and unrelenting program of reforestation is imperative.

In addition to turpentine and rosin, byproducts obtainable from the yellow pine are rosin oil, pine oil, wood pulp and paper. On account of the threatened exhaustion of pulp woods in the Northern states, the pulp and paper industry of the country is now moving into the South. Northern spruce requires from 40 to 80 years to attain pulpwood size—an average yield per acre of only one-half cord of wood per year. Florida has vast tracts of land whose soil is peculiarly adapted for the growth of yellow pine, and where natural reforestation can take place within fifteen or twenty years—a yield of nearly two cords of wood per acre per year, perpetually.

Kraft paper is manufactured from the yellow pine by the sulphate process, which being alkaline, dissolves the pitch and yields a strong and durable product. The Forest Products Laboratory of the United States has pointed out that the ease and rapidity with which the southern pine can be reproduced argues for an expansion in the South of the wrapping paper, container board and book paper industries, and for the development of a successful process for the manufacture of news print from yellow pine. Within ten or fifteen years it is likely that the South will have as large a proportion of the paper and pulp mills of the country as today she has of the cotton mills. By foresight and prompt and sustained action in the work of reforestation, Florida should be able to secure a large share of this coming Southern industry.

Botanical Drugs.—A Florida industry which promises to become of considerable importance is the culture of medicinal plants and herbs, used for the manufacture of certain drugs, such as aloes, cassia, cocaine, herbane, jalap, menthol, castor oil, nux vomica, etc. The subtropical climate and the soil are favorable to the growth of many of these plants, which for centuries have been imported from the other side of the globe.

Phosphate Rock.—The phosphate rock of Florida is classified as "hard-rock" and "pebble" phosphate. In the hard-rock deposits there is a wide variation in the location, the depth beneath the surface, the extent laterally and downwards, the quantity and the quality and the ease of recovery of material suitable for shipment. The land-pebble phosphates of southern Florida are much more uniform in their mode of occurrence. The best grade of land pebble rock contains about 75 or 76 per cent of tri-calcium phosphate. Hard-rock phosphate contains from 79 to 83 per cent. Nearly all of the hard-rock phosphate is exported. The locations of the phosphate rock deposits of Florida are indicated in the accompanying map (compiled by E. H. Sellards of the Florida State Geological Survey), which shows also the location of lime plants, brick plants, ball clay mines and fullers earth mines.

The principal uses of phosphate rock are (1) for export as such; (2) for the production of "ground phosphate rock" used as a slowly-available fertilizer; and (3) for the manufacture of acid phosphate, the chief ingredient of commercial fertilizer. Smaller quantities of the rock are used for other purposes, such as the manufacture of matches, phosphoric acid, and phosphates of ammonium and sodium, etc. Some of the phosphates in turn are used in the manufacture of baking powder, and others are marketed, under various trade names, as cleaning powders. Recently considerable phosphate rock has been used for the manufacture of double- and treble-superphosphate, and within the past few years a large plant for the production of this high-grade fertilizer has been established and put into operation at Tampa.

The total production of Florida phosphate rock in 1926 was 2,708,207 long tons, valued at $8,683,508. Florida in that year produced 84 per cent of the total production of the United States. Table I gives the production and value of Florida phosphate rock, from 1900 to 1926 inclusive. From the beginning of phosphate rock mining in Florida in 1888 to the close of 1924, Florida produced 49,058,753 long tons, with a total valuation of $192,174,145. The U. S. Geological Survey estimates that the land pebble field alone contains at least 288,000,000 long tons of mineable phosphate rock.

Fertilizer.—One hundred per cent of the acid phosphate used in the fertilizer manufactured in Florida is made from Florida phosphate rock. Of the fertilizer consumed in Florida, 93 per cent is manufactured within

Table I.—Production and Value of Phosphate Rock in Florida, 1900-1926

Year	Land Pebble		Hard Rock		Total	
	Long Tons	Value	Long Tons	Value	Long Tons	Value
1900	221,402	$612,703	424,977	$2,229,373	706,243	$2,983,312
1901	247,454	660,702	457,568	2,393,080	751,996	3,159,473
1902	350,991	810,792	429,384	1,743,694	785,430	2,564,197
1903	390,882	885,425	412,876	1,988,243	860,336	2,986,824
1904	460,834	1,102,993	531,081	2,672,184	1,072,951	3,974,304
1905	528,587	1,045,113	577,672	2,993,732	1,194,106	4,251,845
1906	675,444	2,029,202	587,598	3,440,276	1,304,505	5,585,578
1907	675,024	2,376,261	646,156	4,065,375	1,357,365	6,577,757
1908	1,085,199	3,885,041	595,743	4,566,018	1,692,102	8,484,539
1909	1,266,117	4,514,968	513,585	4,026,333	1,779,702	8,541,301
1910	1,629,160	5,595,947	438,347	3,051,827	2,067,507	8,647,774
1911	1,992,737	6,712,189	443,511	2,761,449	2,436,248	9,473,638
1912	1,913,418	6,168,129	493,481	3,293,168	2,406,899	8,461,297
1913	2,055,482	6,575,810	489,794	2,987,274	2,545,276	9,563,084
1914	1,829,202	5,442,547	309,689	1,912,197	2,138,891	7,354,744
1915	1,308,481	3,496,501	50,130	265,738	1,358,611	3,762,239
1916	1,468,758	3,874,410	47,087	295,755	1,515,845	4,170,165
1917	2,003,991	5,305,127	18,608	159,366	2,022,599	5,464,493
1918	1,996,847	5,565,928	62,052	377,075	2,067,230	6,090,106
1919	1,360,235	5,149,048	285,467	2,452,563	1,660,200	7,797,929
1920	2,955,182	14,748,620	400,249	4,525,191	3,369,384	19,464,362
1921	1,599,835	8,604,818	175,774	1,806,671	1,780,028	10,431,642
1922	1,870,063	7,035,821	188,084	1,308,201	2,058,593	8,347,522
1923	2,348,137	7,987,752	199,516	1,071,675	2,547,653	9,059,427
1924	2,289,466	7,387,897	143,115	629,579	2,432,581	8,017,476
1925	2,758,315	8,081,137	171,649	707,933	2,929,964	8,789,070
1926	2,591,943	8,218,200	116,264	465,308	2,708,207	8,683,508

the State. In 1925 the consumption of fertilizer in Florida amounted to 400,000 tons, valued at about $16,000,000.

Cement and Concrete Products.—Florida probably consumed more cement per capita in 1925 than any other state in the Union. Her consumption of portland cement in that year was approximately 5,000,000 bbl. of which 800,000 bbl. were imported from Europe, and the remainder from other states. This year two portland cement plants have been established in Florida, one at Tampa with a capacity of 1,670,000 bbl. per year, and the other at Ocala, of approximately 1,000,000 bbl. per year capacity.

The manufacture of concrete blocks, brick, tile and sewer pipe has become one of Florida's established industries, the value of these products being probably several million dollars annually. Concrete sewer pipe has practically supplanted terra cotta pipe in Florida.

Clay, Kaolin.—Four plants were reported actively engaged in mining sedimentary kaolin in Florida in 1925, at Edgar, Leesburg, Okahumpka (Lake County) and Crossley (Putnam County) respectively. The deposits occur as a bed of white clay-bearing sand, from 6 to 30 or more feet deep, with an overburden of soil and sandy surface materials varying in thickness from 6 to 20 feet. The deposits as mined contain from 60 to 75 per cent of rather coarse quartz sand. The clay is removed from the sand by washing, the washed product representing about 15 per cent of the original raw material. The washed clay is a high-grade product, plastic, white-burning and refractory. It is used in various proportions mixed with other clays in the manufacture of chinaware, semi-porcelain, electrical porcelain, sanitary ware, and floor and wall tile. Recently it has been used as a filler in the rubber industry and as a paper filler. Most of this kaolin is shipped to the potteries of New Jersey, Ohio, New York, West Virginia, Illinois, Indiana and

Phosphate Deposits and Brick, Lime and Clay Plants in Florida

other States. One Florida pottery uses this clay in making ornamental wares, as well as floor and wall tile. With the clays of central Georgia close at hand to furnish raw material for the necessary mixtures, the establishment in Florida of potteries for the production of hotel china, sanitary porcelain and the like, is probably only a question of time.

Fullers Earth.—Fullers earth is produced chiefly in Gadsden and Manatee counties. Prior to 1924, Florida led in the production of this commodity, but in the year mentioned Georgia took first rank, with Florida second and Texas third. These three states produced 93 per cent of the output in 1924. In 1923, Florida's output was valued at $1,000,000.

Ilmenite and Zircon.—Ilmenite and zircon are produced from beach sands at Mineral City, about five miles south of Pablo Beach, Duval county. Operations there are carried on by Buckman and Pritchard, Inc., representing the owners, the National Lead Co., of New York.

Peat.—It is thought by some that Florida's greatest asset consists in the two billion tons of high-grade peat known to exist in the State. Through the medium of the gas-producer, this peat constitutes a potential source of low-priced power. Much of the peat contains between two and three per cent of organic nitrogen. The producer gas from such fuel could be expected to contain from 12 to 25 pounds of recoverable ammonia (NH_3) per ton of peat consumed. The ammonia could be readily used in the manufacture of fertilizer.

In 1924 only three peat plants reported production. The total output amounted to 2,758 short tons, valued at $23,928, and all of it was marketed as a nitrogenous fertilizer filler. The three companies referred to were operating at Fellsmere, Dundee and Zellwood.

Table II.—Summary of Mineral Production in Florida for 1921, 1922, 1923 and 1924

Mineral Products	1921		1922		1923		1924	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Phosphate (long tons)								
Land pebble	1,599,835	$8,604,818	1,870,063	$7,035,821	2,348,137	$7,987,752	2,289,466	$7,387,897
Hard rock	175,774	1,806,671	188,084	1,308,201	199,516	1,071,675	143,115	629,579
Soft rock	4,419	20,153	446	3,500	....	....	....	....
Total phosphates	1,780,028	10,431,642	2,058,593	$8,347,522	2,547,653	$9,059,427	2,432,581	$8,017,476
Ball clay, fullers earth, peat, zircon, ilmenite (short tons)	86,294	1,504,574	107,684	1,666,260	115,990	1,782,718	122,786	1,860,847
Lime, limestone and flint (short tons)	589,359	638,272	824,150	857,913	1,507,999	1,572,768	2,987,951	3,097,703
Common brick, pottery, tile and sand-lime brick	....	286,522	....	368,149	....	393,323	....	452,053
Sand and gravel (short tons)	160,445	97,324	246,849	147,924	513,245	290,082	546,917	375,853
Mineral waters (gallons)	321,472	28,365	1,004,984	57,305	1,697,197	131,781	1,861,897	135,357
Total value		$12,986,699		$11,445,073		$13,230,099		$13,939,289

CHEMICAL ENGINEER'S BOOKSHELF

Wood as Chemical Raw Material

THE CHEMISTRY OF WOOD. By *L. F. Hawley*, Senior Chemist, Forest Products Laboratory, Madison, Wis., and *Louis E. Wise*, Professor of Forest Chemistry, New York State College of Forestry, Syracuse University. American Chemical Society Monograph Series. The Chemical Catalog Company, Inc., New York. 334 pages. Price, $6.

Reviewed by M. H. HAERTEL

ACCORDING to the authors, this is "a pioneering adventure"—"an attempt to bring together, within the compass of a single book, data pertaining solely to the chemistry of wood." The monograph not only presents the results of purely scientific investigations on wood chemistry, it also indicates deficiencies in our knowledge, thus to stimulate further study. It is expressly stated that an account of the practical recovery of industrial chemicals is not the object. (Incidentally, this was done a few years ago in admirable fashion in Hawley's "Wood Distillation.") Notwithstanding this disclaimer, the wood chemical manufacturer, the pulp producer, the lumberman, and the user of wood in industry will profit by a study of the volume.

There are five parts. Part I,—the Introduction—is devoted to definitions and to the physical structure of woody plants. In these first few pages are pointed out some of the unexplored fields that can be studied to good purpose. Part II,—"Chemical Components of Wood" —has chapters on cellulose, polysaccharides, lignin, its derivatives and constitution, and the extraneous components of wood, such as the tannins, oils, and organic nitrogen compounds.

Part III—"Proximate and Ultimate Analysis"—a combination of scientific determinations and their practical application. The introductory chapter on ultimate and proximate analysis of wood calls attention to the hazards of positive assertions concerning the composition of so variable a substance. "The reagents used in the analytical study of a heterogeneous material like wood, undoubtedly cause chemical changes in some of the components of the wood and they never yield cellulose or lignin fractions that can be considered 'pure' chemical entities which occur in the original wood. It is, therefore, dangerous to allow an analytical procedure to become a fetish and to attempt to make analytical data the basis for speculations on the constitution of wood constituents." This same spirit of caution permeates the remaining chapters of Part III,—those on the determination of cellulose, pentosans, and hexosans, and lignin, together with a concluding chapter on the significance of analytical data.

Part IV—"Decomposition of Wood"—, Part V—"Wood as an Industrial Material"—are of immediate interest to the practical operator. We find the same caution in making positive statements concerning matters on which our knowledge is still indefinite. There are numerous tables of great value. The chapter headings of Part IV show that no important interests have been forgotten. Combustion of Wood; Decomposition of Wood by Heat (for wood distillers); Hydrolysis of Wood (for those interested in cellulose); Delignification of Wood (for the wood pulp people); Decomposition by Concentrated Alkali. The two chapters of Part V—"Physical Properties" and "The Deterioration of Wood"—form a fitting conclusion to this thought-provoking book. Especially the final paragraphs on the effect of decay on the value of wood for industrial purposes give rise to interesting speculation.

* * * *

For Users of Metals

THE FATIGUE OF METALS, with Chapters on the Fatigue of Wood and of Concrete. By *H. F. Moore*, Research Professor of Engineering Materials, University of Illinois and *J. B. Kommers*, Associate Professor of Mechanics, University of Wisconsin. McGraw-Hill Book Company, Inc., New York. 319 pages. price, $4.

Reviewed by D. J. MCADAM, JR.

THE purposes of this book, as stated by the authors are as follows: "To summarize the more important experimental facts concerning the strength of metals under repeated stress; to review briefly the more important of the current theories; to give a brief description of apparatus and methods." In the midst of the recent rapid development of this subject, it was a difficult task that the authors undertook. The task, however, was well done.

The first two chapters are introductory and historical. Chapter III discusses slip, overstrain and hysteresis. Chapter IV discusses facts and theories of fracture under repeated stress. Chapter V gives a complete description of machines and specimens used in repeated stress tests.

Chapter VI gives characteristic results for fatigue tests. Typical stress-strain graphs are presented illustrating the behavior of a great variety of metals or alloys under repeated stress. In tabular form are listed the chemical composition, heat-treatment, and endurance limits in comparison with other physical properties for a great variety of carbon and alloy steels, cast iron, and non-ferrous metals. This chapter also discusses the effect of temperature on the endurance limit.

Chapter VII discusses the effect of range of stress on fatigue strength. The great majority of fatigue tests have been made with complete reversal of stress per cycle. Numerous tests, however, have been made with incomplete reversal, or even with range between two tension or between two compression values. This chapter discusses the variation of the stress range as it is moved from its central position toward either of the above mentioned extremes. The various theories are carefully and impartially presented. The general impression given by this chapter, however, is that the uncertainties of this subject should be cleared up by additional investigation.

Chapter VIII discusses the effect of notches, grooves, scratches, fillets, flaws, non-metallic inclusions and other "stress raisers." Corrosion-fatigue of metals is also briefly discussed in this chapter. Chapter IX gives some interesting examples, with illustrations, of fatigue failures in service. Chapters X and XI present considerable data on fatigue of wood, cement and concrete.

This book is an excellent example of technical literature. The material is well arranged and the language is clear. This survey of the subject should be welcomed by technical men and by users of metals.

* * * *

Aluminum Paint

ALUMINUM BRONZE POWDER AND ALUMINUM PAINT. By *Junius David Edwards*. Chemical Catalog Co., New York. 104 pages. Price, $3.

Reviewed by E. F. HICKSON

THIS book will no doubt prove extremely interesting both to the paint technologist, and to the general user of paint. The subject matter is clear and concise, and the information can be considered authoritative. It is highly recommended.

It is interesting to note the increased use of aluminum paint in recent years. Six of the ten chapters in the book are devoted to it. It is only within the past ten years that this paint has really found itself for outdoor use. Prior to that time, so-called bronzing liquids were often mixed with aluminum for exterior use. But as the author states, not every aluminum paint is a good paint. It is largely through his efforts, however, that the intelligent use of the paint, particularly for the outdoor protection of metal—and also wood—has been brought about. Today aluminum paint rightly takes its place as one of the "standard" paints both for indoor and outdoor use.

* * * *

Inorganic Chemical Series

TEXTBOOK OF INORGANIC CHEMISTRY. Edited by *J. Newton Friend*. In ten volumes. Charles Griffin & Co., Ltd., London, and J. B. Lippincott Company, Philadelphia.

VOLUME III, PART *II*. BERYLLIUM AND ITS CONGENERS. By *Joshua C. Gregory* and *May Sybil Burr*. 342 pp. Price $9.50.

VOLUME VII, PART I. OXYGEN. By *J. Newton Friend* and *Douglas F. Twiss*. 370 pp. Price $8.50.

VOLUME IX, PART II. IRON AND ITS COMPOUNDS (SECOND EDITION). *By J. Newton Friend*. 265 pp. Price $7.50.

This comprehensive series initiated more than ten years ago under the general editorship of Dr. J. Newton Friend, Carnegie Gold Medalist, already begins to measure up to the editor's conception of a complete encyclopedia of the elements. Using the periodic table as its basis of classification, the elements of each of the periodic groups have been treated in the successive volumes numbering from I to IX. Naturally, for some volumes more than one part has been required so that to date the series includes Vol. I, II, III part II, IV, V, VII parts I and II, VIII and IX parts I and II. Of the major volumes only Vol. VI which will deal with the fifth group of the periodic table remains to be published, although obviously there are many subdivisions awaiting treatment.

The reader familiar with the comprehensive and exhaustive character of the series will require but little description of the three most recent additions to this work. Beryllium and its congeners—magnesium, zinc, cadmium and mercury—are elements of constant scientific and industrial interest. Oxygen is generally recognized as the most important of the elements and the fact that Vol. IX part II on "Iron and its Compounds" is already in its second edition testifies to the substantial character of the treatment that Dr. Friend has given to this important subject.

Gas Analysis

METHODS OF THE CHEMISTS OF THE UNITED STATES STEEL CORPORATION FOR THE SAMPLING AND ANALYSIS OF GASES. Third Edition. Published and sold by the Bureau of Instruction, Carnegie Steel Company, Pittsburgh, Pa. 187 pages. Price, $2.

A special committee of the chief chemists of the subsidiary companies of the United States Steel Corporation worked more than two years in carrying through the revision and study that have resulted in this third edition. Prior editions of this work have won for it a reputation for reliability and completeness that have made it a standard guide and reference book in all laboratories dealing with industrial gases.

The book is more than a description of analytical methods. It emphasizes the importance of accuracy and recognizes the fact that accuracy can never be obtained by blind following of directions. Accordingly the information it contains on sampling, analysis, measurement and combustion of gases make it of interest not only to chemists but to combustion engineers and executives concerned with the combustion or handling of fuels.

* * * *

ALLEN'S COMMERCIAL ORGANIC ANALYSIS. VOLUME V. 4TH EDITION. Edited by *S. S. Sadtler, E. C. Lathrop* and *C. A. Mitchell*. Tannins, by *M. Nierenstein*. Writing, Stamping, Typing and Marking Inks, by *C. Ainsworth Mitchell*. Printing Inks, by *John B. Tuttle*. Amines and Ammonium Bases, by *H. E. Cox*. Leather, by *A. E. Caunce*. Natural Coloring Matters, by *W. M. Gardner*. Food Colors, by *W. E. Mathewson*. Benzene and its Homologues, by *J. Bennett Hill*. Aniline and its Allies and Naphthylamines, Pyridine, Quinoline and Acridine Bases, by *A. B. Davis*. P. Blakiston's Son & Co., Philadelphia. 700 pp. Price $7.50.

As those who have had occasion to use this important series have learned from previous experience, Allen's Commercial Organic Analysis is considerably more than a compilation of analytical methods or laboratory procedure. It attempts to give in addition the properties, composition and commercial utility of "the organic chemicals and products employed in the arts, manufactures, commerce, medicine and science." In the present edition, Volume V has been fully revised, many of the sections rewritten and the whole rearranged in such way as to make it, in effect a preparation for the new Volume VI on coal-tar colors and synthetic dyestuffs.

* * * * *

Specifications for Chemicals

CHEMICAL SPECIFICATIONS YEARBOOK. *M. N. Conklin*, editor. Published by Chemical Specifications, Inc., New York. 142 pp. Price $5.

This yearbook is offered as an aid to purchasing agents and to others connected with the chemical industry. Detailed specifications are given for the more important chemicals, with descriptions of the methods of manufacture and uses. A valuable feature of the book is the separate listing of manufacturers, jobbers and importers of each chemical.

* * * *

British Chemical Directory

BRITISH CHEMICALS, THEIR MANUFACTURE AND USES: Published in London by Ernest Benn, Ltd.; American representative, D. Van Nostrand Company, New York. 286 pp. Price $3.50.

This work is the official directory of the Association of British Chemicals Manufacturers. It contains a full list of the members of the Association and a classified list of British chemicals with their uses and applications.

Readers' Views and Comments

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Is Coal Tar a Fuel or a Chemical Raw Material?

To the Editor of Chem. & Met.

Sir—The Department of Commerce published a pamphlet on May 20, 1927, entitled "Coke and By-Products in 1924," this being a part of "Mineral Resources of the United States, 1924, Part II." Pages 663 to 728 are occupied with a report on "The Marketing of Coal Products," by R. S. McBride which in general is a very useful and accurate summary of conditions. There are, however, several sections where the opinion of the writer is presented in such an emphatic way as apparently to give to it the authority of fact whereas this opinion may have represented the views of persons rather interested in one commercial phase of the subject. We refer especially to the section dealing with utilization and marketing of coal tar and coal-tar pitches.

At the very start of the discussion (page 702), speaking of tar as a fuel it is stated.

> Usually the substitute fuel would cost substantially as much as the tar sold and all the annoyance and uncertainty of managing the sales of tar and the purchase of substitute fuel would be incurred without any large financial advantage.

and on the same page the author, speaking of tar distillation, assumes that the products are creosote oil and coke and concludes

> * * * Unless the market for still coke is unusually good, the profits from such an operation are likely to be negative.

The production of still coke, although considerable in the petroleum industry, represents a negligible amount in the coal-tar industry due to the more enlightened methods of modern production.

On page 703 the author refers to still coke only as a fuel to be burned on grates although this practice is substantially non-existent. The main production of coke from pitch is made in coking ovens adapted to the purpose. His description of the coke as being soft and friable and useless where strength is required is incorrect as it displays exactly opposite characteristics. When properly made it is as strong as foundry coke. Containing only about 0.3 per cent ash, with very low sulphur content and few other impurities, it is an ideal metallurgical reducing agent.

On page 706 and 707 the author refers to certain small companies that buy large quantities of tar to produce the primary products, and he states further that they can use only a small part of all the tar produced. For years there have been no extended periods when there was a national excess of tar. More would have been purchased by the distillers, had the producers been willing to sell it.

On page 707 the author refers to the production of synthetic phenol. Phenol can be made more cheaply from tar than by any existing synthetic process and the co-existing natural compounds sold at a profit. Cresylic acid is made simultaneously with the phenol from tar. No commercial synthesis is available for this product and it is in greater demand for the production of synthetic resins than is phenol itself. Synthetic phenol plants can only operate as a necessity when there is a natural phenol shortage due to the burning of tar as a fuel.

On page 709

> As with any commodity where the supply largely exceeds the demand, tar sold for refining can command very little, if any more, than tar sold as fuel.

It is admitted that tar is an excellent fuel for steel making, but it is an economic waste to use it for boiler firing when other fuels are cheaper and equally as good.

The whole tenor of the report, in our opinion, is to say to tar producers—"Burn tar if you can, sell it if you must, but don't expect to get much for it. By all means do not even consider distilling it yourself for you will only lose money!"

This picture is far from a correct one and does not represent the true state of affairs—certainly not under 1927 conditions. First, it is not necessary to make coke to get distillation yields of well above the 50 per cent stated by Mr. McBride. Efficient distillation will give about 60 per cent by volume from the average coke-oven tar, yielding a liquid pitch that has at least a value equal to coal if recharged into the by-product ovens along with coal. If pitch is carbonized properly, pitch coke is too valuable to be used as an ordinary fuel and commands values far in excess of the best grades of coke from coal. The large special metallurgical uses of pitch coke have been entirely ignored in this report, yet this development has been of utmost importance in the tar refining industry. Several large tar producers have stopped burning tar and are distilling it with successful results. This field and market are open to others.

We do not contend that all tar producers should distil their production—in some cases the probable profit does not warrant the necessary investment. There are producers, however, who either burn or sell tar when a distilling operation would show handsome returns on the necessary capital. This, of course, assumes that the tonnage is sufficient, the quality of the tar suitable and local conditions relating to markets and facilities satisfactory. This has been demonstrated by the established success of the tar refiners who erect distilling plants "over the fence" from the coke ovens provided they are fortunate enough to negotiate a sufficiently long contract period of tar supply. In steel plants, for instance, the proper working of tar can be made to show an extra by-product credit of from 20 to 35 cents per ton of steel produced which is no inconsiderable figure.

Weiss and Downs, Inc. J. M. Weiss.
New York, N. Y. C. R. Downs.

Wishes to Encourage More Complete Utilization

To the Editor of Chem. & Met.:

Sir—It would be very unfortunate if many readers gained from my recent report on marketing of coal products the same impression as that apparently held by Messrs. Weiss and Downs. Their letter indicates an entire misunderstanding of the purpose held by myself and the government departments involved, for they seem to feel that the chapter on tar products was intended to discourage further development of tar refining. Exactly the opposite was intended and hoped for.

From the fragmentary paragraphs quoted by Messrs. Weiss and Downs an impression may be gained quite out of harmony with the real significance of the whole report. Those interested should therefore refer to the complete report for proper understanding of the quotations, especially those taken from pages 702 and 703.

To avoid misunderstanding, however, one detailed issue ought to be raised. My remarks on the soft and friable character of coal-tar coke (page 703) refers to still coke, as a reading of the context clearly shows, and not to pitch coke made by treating pitch in a coke oven. Still coke does have the properties ascribed to it. Pitch coke is a new development on a commercial scale and in 1925 when I was writing this report the confidential character of my information permitted reference to it only in the following words (page 703): "This coke as sometimes specially prepared has strength enough for special metallurgical uses." The extension of the production of pitch coke, to which Messrs. Weiss and Downs have largely contributed, is an example of the gradual development of a balanced market for tar products on which the expansion of tar refining depends.

Aside from these matters of detail the comments offered by Weiss and Downs are, it appears to me, essentially a concurrence with the broad principles carefully set forth in the original report in the following language:

> About half of the coal tar produced is burned under boilers or in metallurgical furnaces of plants affiliated with the coke plant where the tar is made. This debasing of a potentially valuable raw material of industry is justified only by the greater immediate profit returned to the producer.
>
> Much more tar would be refined if a well-balanced demand existed for all of the primary products of tar distillation. It is not economically practicable to refine tar unless all of these primary products of distillation can be sold promptly and at favorable prices.
>
> Large quantities of tar products are imported. There is no obvious reason why a considerable part of the market so supplied could not be filled by American producers who refine tar from gas works or coke ovens. This development will, however, come slowly in order to insure properly balanced markets, stability, and permanent profits.

This, indeed, forms not only a major portion of the original "Summary," but also an entire agreement with their argument as to the commercial aspects of synthetic phenol, the probability of further tar refining at steel works, and the economic waste involved in tar burning where a market for tar products exists. Fortunately the "national excess of tar" which some may feel has been disturbing Messrs. Weiss and Downs, is actually one of the most encouraging factors for those who anticipate further development of tar refining. I believe that they will agree that the existence of such surplus of tar above the requirements for the refining industry is the best insurance possible against either shortage or excessive price for this raw material.

There have already been voluminous controversies published as to the economic opportunity for the tar refiner in competition with the synthetic phenol manufacturer. In the last analysis all of this argument goes to prove the conclusion on which Weiss and Downs and myself undoubtedly agree, namely, that synthetic phenol will be made in increasing quantities whenever it proves financially profitable to do this. There is not, nor is there ever likely to be, any shortage of raw materials nor any technologic difficulty to restrict phenol production from tar.

It is not clear upon what basis your correspondents have made the estimate in the last sentence of their letter of extra byproduct credits amounting to 20 to 35 cents per ton of steel. It appears, however, that these are based upon as assumption that tar at a steel works' coke plant has an actual or a fuel-replacement value only as great as the bookkeeping value customarily ascribed to it. The fact is that the tar is worth distinctly more for open-hearth furnace firing than is indicated by the interdepartment bookkeeping value assigned. If estimate be made as to the merit of refining this tar and due account be taken of the real intrinsic merit of tar as an open-hearth fuel the margin is not typical of anything like the magnitude implied by the comment. Had it been as great as this in fact, the metallurgical industry would long since have arranged to realize upon it.

The need for further development and more complete utilization of coal products is great. It is hoped that the government report on which Messrs. Weiss and Downs comment will be found to encourage those who are active in this field and who have been, like these two engineers, long and zealously active in promoting the welfare of the coal-products industry.

Washington, D. C. R. S. McBride.

* * * *

Determination of Clarifying Area

To the Editor of Chem. & Met.:

Sir—On page 507 of the August issue in an article by me entitled, "Determination of Area Required for Clarification," through an error in transcribing, formula (1) is incorrect. This should be

$$M = \frac{100\,L\,(S-P)}{P\,(S-L)}$$

The proof of this formula is interesting and few engineers of my acquaintance are familiar with it: Assume a unit volume of pulp having $S.G. = P$, composed of liquid, $S.G. = L$, and solid, $S.G.$ (dry) $= S$. Let per cent moisture (by weight) $= M$. Then:

Wt. of unit vol. of pulp $= P$

$= \text{vol. of liquid} \times L + \text{vol. of solid} \times S$

Vol. of liquid $\dfrac{M\,P}{100\,L}$

Vol. of solid $= 1 - \text{vol. of liquid} = 1 - \dfrac{M\,P}{100\,L}$

Hence, $P = \dfrac{M\,P\,L}{100\,L} + \left(1 - \dfrac{M\,P}{100\,L}\right) S$ and

$$M = \frac{100\,L\,(S-P)}{P\,(S-L)}$$

Noel S. Cunningham.

Bethlehem, Pa.

Selections from Recent Literature

BITUMENS. Stern. *Farbe und Lack,* July 6, pp. 365-6. A review of the chemical nature and industrial uses of asphalts and pitches, natural and artificial.

NITROGEN. G. P. Pollitt. *Journal of the Society of Chemical Industry,* July 15, pp. 291-5T. An account of the growth and present status of the synthetic nitrogen industry in Great Britain. Illustrated.

SYNTHETIC RESINS. D. A. Spencer and H. D. Murray, *Chemistry and Industry,* July 15, pp. 637-9. Not all the manufacturing difficulties have yet been overcome in making the condensation products of aldehydes with phenols, ureas, etc. Permanent transparency and certain dyed color effects are yet to be attained. A resin which would expand slightly on setting would be a great boon in molding. Application of synthetic resins to such articles as phonograph records is an attractive field yet to be developed.

CONCENTRATING ACIDS. W. Strzoda. *Chemiker-Zeitung,* July 13, pp. 525-6. The Strzoda system of concentrating sulphuric and nitric acids consists essentially of a plurality of large externally-heated pipes in series. The vapor is separated in a condensing tower into water vapor and sulphuric acid. The water is condensed in a second tower. The only modification needed for applying the system to nitric acid is the addition of more pipes. This production of highly concentrated acid in one step involves some loss, but not over 50 kg. per 24 hours in a plant operating 8 pipes with sulphuric acid.

VISCOMETRY. Gustav Guenther. *Chemiker-Zeitung,* July 13, pp. 526-7. The new Klever viscometer is described and illustrated. It is a rapid but reliable instrument for judging the quality of glue and gelatin, useful both in controlling the manufacture of these products and in estimating their quality in the consuming industries.

SEAWEED. W. Singleton. *Industrial Chemist,* June, pp. 267-70. Chemical composition of varieties of Fucus, Laminaria and other seaweeds; commercial recovery of iodine, alkali salts and algin from dried seaweed; production of foods, alcohol, aliphatic acids, etc.

DYEING RAYON. R. P. Foulds. *Industrial Chemist,* June, pp. 273-6. Modern methods of dyeing the artificial silks; obtaining special effects; dyeing mixed yarns of cotton or animal fibers with acetyl silk; restoring luster.

PARAFFINS. Franz Fischer and Hans Tropsch. *Berichte der deutschen chemischen Gesellschaft,* June, pp. 1330-4. In the catalytic treatment of water gas, formation of high-melting paraffin hydrocarbons from CO and H_2 was observed. The highest members of the series had about 70 C, and molecular weight about 1,000. Yield is better at atmospheric pressure than a 10-15 atm.

COLLOIDS AND COAL. H. Winter. *Kolloid-Zeitschrift,* July, pp. 233-42, The relation of colloidal phenomena to the origin, structure and properties of coal is discussed. On the practical side, many of the innumerable experiments for treating and utilizing coal have been based, whether knowingly or not, on colloidal properties or processes. The coal industry could probably benefit greatly from scientific study and application of the colloidal problems involved in producing, treating and using coal. Illustrated.

COLLOIDS AND METALLURGY. F. Sauerwald. *Kolloid-Zeitschrift,* July, pp. 242-53. Dispersoids and degree of dispersion have a great influence in metallurgical processes and products. Particle size, strength and orientation govern to a large extent the mechanical properties of metals and alloys. The much-discussed question as to whether there is a critical degree of dispersion for certain properties cannot be answered for steel; but in non-ferrous alloys evidence has been found of a critical degree of dispersion with respect to hardness. Illustrated.

OIL DISPERSIONS. Laszlo Auer. *Kolloid-Zeitschrift,* July, pp. 288-92. Among the substances which charge oil surfaces negatively with respect to air, formic acid was found to have remarkable power of dispersion. This property can be utilized in promoting the formation of solid gels, either in thin films or in mass, e. g. in accelerating the drying of paint and varnish films. The effect is sufficiently definite to be useful also in the quantitive evaluation of fatty oils.

ANTI-KNOCK AGENTS. Chas. Moreu, Chas. Dufraisse and R. Chaux. *Chimie et Industrie,* July, pp. 1-12. In a study of the relation of anti-knock effect to anti-oxygenic properties, many agents were tried in paraffin to observe the effect on autoxidation. These included aromatic amines; organic compounds of Pb, As and S; poly-phenols, tetralin and decalin; dyes, and other substances, mostly organic. Curves, showing the effect on rate of oxidation, are given.

NITRATES. Valentin Dominik. *Chimie et Industrie,* July, pp. 24-32. A process has been worked out in Poland for converting low-grade sylvinite to nitrate. The Cl is recovered as such and may be sold or converted to HCl, according to market conditions. The process consists in oxidizing with mixed nitric and sulphuric acids; the latter absorbs the NOCl and oxides of N, so that only the Cl and HCl escape as gases. Several economic advantages are claimed.

DYE CHEMISTRY. Fritz Mayer. *Zeitschrift fur angewandte Chemie,* Aug. 4, pp. 883-5. A review of progress in dye synthesis, and chemical study of natural dyes, in the years 1921-1926.

DYEING LEATHER. F. Ullmann. *Kunststoffe,* July, pp. 153-4. A recent development has made possible the dyeing of leather in shades fast to light and water, by the use of substantive dyes coupled with diazo compounds. Directions for yellow are given. For comparison, some older methods for producing satisfactory effects in yellow, red, purple, blue, green, violet, brown, gray and black.

PLASTICIZING. Otto Manfred and Josef Obrist. *Kolloid-Zeitschrift,* April pp. 348-61; June, pp. 174-80. The effect of plasticizing treatments, such as milling and masticating, on natural and artificial plastics was studied, with particular reference to mechanical and elastic properties. The phenolic resins, such as bakelite, behave as if they were farther from the optimum degree of dispersion than the urea resins, such as pollopas. Methods and equipment for plasticizing are described.

LACQUERS. Hans Wolff. *Farbe und Lack,* July 27, pp. 401-3. The softening effect of certain solvents when retained in the lacquer film depends on the composition of the lacquer, especially the resin and pigment content. Solvent thus retained sometimes has a beneficial effect even if a softener is already present. An excellent example of such a solvent is ethyl lactate.

DRYING SALTS. M. A. Rakusin and D. A. Brodski. *Zeitschrift für angewandte Chemie,* July 21, pp. 836-40. An experimental comparison of the use of direct heat, boiling alcohol and hot dry air for dehydrating hydrated salts such as borax, $NaHCO_3$ and the sulphates of Na, Mg, Ni, Co, Cu and Al (alum). In many cases it is difficult to remove the last molecule of water of hydration without calcining.

LIQUEFIED COAL. Spilker. *Zeitschrift für angewandte Chemie,* July 28, p. 872. Not only raw coal but also its pyrolysis products can be successfully berginized. Some coals are better adapted to coking or low temperature distillation than to berginization. There is opportunity for profitable operation of a judicious combination of coking and berginization, the necessary H_2 being generated from the coke, or taken from water gas. Among the products, methanol and benzene can be blended to give an excellent motor fuel.

HEATING LIQUIDS. Hack. *Chemiker-Zeitung,* July 20, pp. 545-6. Methods are shown for calculating the heating surface and the steam consumption in heating liquids in open wood vats. A sample calculation is given and explained.

SOLVENTS AND SOFTENERS. August Noll. *Chemiker-Zeitung,* July 20, pp. 546-8; July 27, pp. 566-7. Properties and uses of solvents and softeners for nitrocellulose and like plastics. Solvents include glycol ethers, esters of various acids and alcohols, cyclohexanones, etc. Softeners include ethyl phthalate, benzyl benzoate, triphenylphosphate and numerous other esters; also oxanilide and other anilides.

WATER GAS. Gwosdz. *Chemiker-Zeitung,* Aug. 3, pp. 585-6. A review

of the origin and technical progress of processes for making water gas from coal dust and powdered coal. There are several advantages over coke as a cheap source of gas of high heating value.

HYDROGENATING NAPHTHALENE. A. Kling and D. Florentin. *Bulletin de la Societe Chimique,* June pp. 864-81. Optimum conditions for hydrogenation in the polycyclic series are essentially different from those which prevail for the fatty compounds. For napthalene and anthracene, hydrogenation at a rate of 10% per hour can be achieved at about 100 kg. per sq. cm. pressure and 475°C. (naphthalene) or 440°C. (anthracene). Of course this rate can be much increased by use of well known catalysts.

Government Publications

Prices indicated are charged by the Superintendent of Documents, Washington, D. C., for pamphlets. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from Bureau responsible for issue.

Analyses of Spindletop, Texas, Crude Oils, by A. J. Kraemer and Peter Grandone. Bureau of Mines Serial No. 2808.

Properties of Typical Crude Oils from the Producing Fields of Venezuela, by A. J. Kraemer. Bureau of Mines Serial 2807.

The Flotation of Oxidized Ores, by Thomas Varley. Bureau of Mines Serial 2811.

Precipitation of Gold and Silver from Cyanide Solution on Charcoal, by John Gross and J. Walter Scott. Bureau of Mines Technical Paper 378. 15 cents.

Identification of Oil-Field Waters by Chemical Analysis, by C. E. Reistle, Jr. Bureau of Mines Technical Paper 404. 5 cents.

Iron Blast-Furnace Reactions, by S. P. Kinney, P. H. Royster, and T. L. Joseph. Bureau of Mines Technical Paper 391. 15 cents.

Passage of Solid Particles Through Rotary Cylindrical Kilns, by John D. Sullivan, Charles G. Maier and Oliver C. Ralston. Bureau of Mines Technical Paper 384. 15 cents.

Petroleum Refinery Statistics 1916-1925, by G. R. Hopkins. Bureau of Mines Bulletin 280. 30 cents.

Summary of Mineral Production in Foreign Countries 1920-1924, by L. M. Jones. Bureau of Mines pamphlet. 15 cents.

Production statistics from 1925 Census of Manufactures—printed pamphlets on: Manufactured Ice; Turpentine and Rosin; Lime and Marble, Slate and Stone Work; Cement and Concrete Products; Beverages, Flavoring Extracts and Flavoring Sirups, Malt. 5 cents each.

Color in the Sugar Industry, by H. H. Peters and F. P. Phelps. Bureau of Standards Technologic Paper 338. 20 cents.

Use of Sulphite Cellulose Extracts as a Tanning Material, by E. L. Wallace and R. C. Bowker. Bureau of Standards Technologic Paper 339. 30 cents.

Organizations Cooperating with the National Bureau of Standards. Bureau of Standards Miscellaneous Publication 96.

Directory of Commercial Testing and College Research Laboratories. Bureau of Standards Miscellaneous Publication 90. 15 cents.

World Trade in Coal Tar Dyes—Germany, by Trade Commissioner W. T. Daugherty, Berlin. Bureau of Foreign and Domestic Commerce, Chemical Division, Series A No. 7.

Hides and Skins—World Production and International Trade, by J. Schnitzer. Bureau of Foreign and Domestic Commerce Trade Promotion Series No. 50. 35 cents.

Commerce Yearbook, 1926, Vol. I.—United States, compiled by the Bureau of Foreign and Domestic Commerce. $1.

Production of Explosives in the United States during the Calendar year 1926, with Notes on Mine Accidents Due to Explosives, by W. W. Adams. Bureau of Mines Technical Paper 426. 10 cents.

Pulpwood Consumption and Woodpulp Production, 1926. Bureau of the Census. 5 cents.

The Use of Solvents for Dewaxing Paraffin-Base Crude Oil, by H. M. Smith, Bureau of Mines Serial No. 2822.

Apparatus for Vacuum Distillation of Lubricating and Heavy Petroleum Oils, by Martin J. Gavin and A. L. Foster. Bureau of Mines Serial 2819.

Caroá Fiber as a Paper-Making Material, by M. B. Shaw and G. W. Bicking. Bureau of Standards Technologic Paper 340. 25 cents.

U. S. Government Master Specifications on the following materials, issued under Bureau of Standards Circular numbers indicated: No. 33, 4th edition, Portland Cement, 10 cents; No. 82, 3d edition, Raw Linseed Oil; No. 89, 3d edition, White and Tinted Paints made on a White Base, Semipaste and Ready Mixed; No. 93, 3d editions, Iron Oxide and Iron Hydroxide Paints; No. 165, 2d edition, Olive Drab Paint; Semipaste and Ready-Mixed; No. 323, Plastic Magnesia Cement (Magnesia-Oxychloride) used as Flooring, Bases, Wainscots, etc.; No. 330, Boiled Linseed Oil; No. 335, Hard Fiber Sheet Packing; No. 336, Metallic-Encased Gaskets; No. 239, 2d edition, Packing Flax; No. 241, 2d edition, Compressed Asbestos Sheet Packing; No. 242, 2d edition, Asbestos Metallic Cloth Gaskets; No. 243, 2d edition, Asbestos Metallic Cloth Sheet Packing; No. 256, 2d edition, Brown (Shrunk) Denim; No. 334, Asbestos Wick and Rope Packings; No. 115, 3d edition, Pneumatic and Solid Rubber Tires and Inner Tubes; No. 186, 2d edition, Typewriter Ribbons; No. 187, 2d edition, Hectograph Ribbons; No. 188, 2d edition, Computing and Recording Machine Ribbons; No. 196, 2d edition, Black Waterproof Drawing Ink; No. 339, Rigging Leather; No. 340, Hydraulic Packing Leather (Vegetable Tanned); No. 342, Hollow Clay Load-Bearing Wall Tile; No. 344, Hollow Clay Floor Tile; No. 345, Common Clay Brick. 5 cents each.

Standard Samples, General Information, ninth edition. Bureau of Standards Circular 25.

Aging of Soft Rubber Goods, by R. F. Tener, W. H. Smith, and W. L. Holt. Bureau of Standards Technologic Paper 342. 15 cents.

Mineral production statistics for 1925—Separate pamphlets from Bureau of Mines on: Rare Metals—Cobalt, Molybdenum, Nickel, Titanium, Tungsten, Uranium, and Vanadium, by Frank L. Hess; Sulphur and Pyrites, by Helena M. Meyer. 5 cents each.

The Function of Steam in the Limekiln, by E. E. Berger. Bureau of Mines Technical Paper 415. 10 cents.

The Pyrotannic Acid Method for the Quantitative Determination of Carbon Monoxide in Blood and in Air, by R. R. Sayers and W. P. Yant. Bureau of Mines Technical Paper 373. 10 cents.

Tarnish Resisting Silver Alloys, by L. Jordan, L. H. Grenell, and N. K. Herschman. Bureau of Standards Technologic Paper 348. 15 cents.

Cresylic Acid. Report of the U. S. Tariff Commission to the President. 5 cents.

Analyses of Crude Oils from the Seminole District, Oklahoma, by A. J. Kraemer. Bureau of Mines Serial 2824.

Mineral production statistics for 1926—Separate pamphlets from Bureau of Mines on: Chromite, by J. W. Furness; Fuel Briquets, by F. G. Tryon; Fluorspar and Cryolite, by Hubert W. Davis, 5 cents each; and Mineral Resources of the United States (Preliminary Summary), by F. J. Katz and Martha B. Clark, 20 cents.

Clay Products and Nonclay Refractories in 1926, mimeographed figures from Bureau of the Census.

Miscellaneous Publications

Standards of The Hydraulic Society, Fourth Edition, 80 pp. Published by the Society. 50 cents.

The standards recommended by The Hydraulic Society are published for the aid of both manufacturers and users of pumps. The book contains definitions, terms and practices relating to the use and manufacture and commercial and technical aspects of pumps.

Benzol Poisoning as an Industrial Hazard. Leonard Greenburg. Publication (1926) of the U. S. Public Health Service which reviews quite completely the history and industrial uses of benzol, prevalence of acute and chronic poisoning in different industries, and the work done by the National Safety Council in its investigation of the hazard. A large number of cases are cited with descriptions of the symptons encountered. 15 cents.

Plastic Refractories. American Refractories Institute. S. M. Phelps, Mellon Institute. In technological paper No. 3, a discussion is given of the uses of plastic refractories with data and photographs covering the physical tests and analyses of four standard brands.

THE PLANT NOTEBOOK

an exchange for OPERATING MEN

Loading Tank Cars with Volatile Liquids

By C. D. Greene
Atlantic Refining Company

The device described below was designed for reducing evaporation losses while loading tank cars with gasoline. Fig. 1 gives a systematic layout of the apparatus used. Variations to fit individual cases will be apparent to the reader. Exhaustive tests have shown that the ordinary method of loading through the open dome of the car entails an evaporation loss of over 20 gal. of gasoline per car loaded. This can be recovered by the use of gas-tight dome covers connected to a gas recovery system, but the large percentage of air in the vapors and the corresponding low extraction yields do not usually warrant this expense except in very large installations.

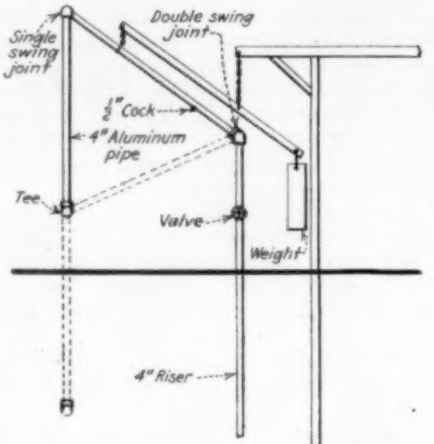


Fig. 1—Loading Device for Tank Cars
A simple counterbalanced loading device which can easily be made from pipe and fittings that will be found in every plant.

As shown in the sketch, by extending the loading pipe to the bottom of the tank, the evaporation loss can be reduced to as low as 5 gal. per car. The use of 4 in. piping for loading assures speed and little agitation in the car while loading. The 4 in. tee on the end of the pipe prevents splashing by diverting the flow toward each end of the car instead of directly against the bottom. The tee and the pipe connecting it to the single swing-joint are made of aluminum and are standard fittings. This eliminates iron-to-iron contact and makes the whole apparatus much lighter than if iron piping were used entirely. The method of counterbalancing, as shown in the drawing, permits this size of pipe to be handled with ease. The counterweight is so arranged that the swing-pipe is counterbalanced in all positions. This means that little effort is necessary to raise the pipe from the track level to a position five or six feet above the tank car dome. It may also be swung horizontally through an angle of 300 deg., so that cars on two adjacent tracks are reached by one riser. Cars can be reached that are spotted 4½ ft. off center. In other words, the train crew is allowed 9 ft. leeway in placing each car.

In actual practice it has been found convenient to overload the counterweight slightly, so that the pipe will rise of its own accord and remain high in the air out of the way. When loading, the tee on the end of the swing pipe need only be placed in the top of the tank car dome. When the gasoline is turned on, its weight is sufficient to lower the pipe to the bottom of the car. After the car is loaded the small vent-cock is opened, allowing the pipe to drain. It then rises automatically to its former position, and is out of the way until it is needed again.

Another advantage of this design is the elimination of the static hazard. There is always positive metallic contact between car and pipe while gasoline is flowing, and there is no troublesome static wire to be lost, forgotten or mislaid.

Stoneware Covers for Electrolytic Cells

A number of acid-proof stoneware covers supplied by the General Ceramics Company have given excellent results at the plant of the Niagara Alkali Company and have shown no evidence of chemical deterioration after 12 years exposure to chlorine gas at a temperature of 80 deg. C. The cells are shown in Fig. 2. Each cell is fitted with six stoneware slab covers cemented into the cell body with a special chlorine-resisting putty.

The service is made especially difficult from a mechanical standpoint due to the fact that each slab must support a dead weight of 200 lb. made up of electrodes and electrical connections.

Several years ago this company tried to lower the first cost of the cell covers by using concrete slabs. Chlorine gas, which has no effect whatever on the stoneware nevertheless was found to attack the concrete covers quickly. The gas seemed to rot or soften the concrete and pieces of the covers, some of them quite large, soon began dropping into the cells and either damaging or at least, reducing the efficiency of the diaphragms. Complete failure of the concrete covers usually occurred after a time not greater than one to two years at the most.

As a result, as often as the concrete covers had to be replaced, stoneware slabs were used, and although the latter covers cost initially three times as much as the concrete, yet the life of the stoneware is so much longer, that, based on a conservative estimate, the eventual saving is somewhat more than 50 per cent and the return on the initial investment is about 12 per cent per year.

This company has also found that ceramic pumps and pipes are considerably more satisfactory than similar accessories made from hard rubber since the latter frequently distort very badly under the influence of hot acids and chlorine gas. With reasonable care, however, ceramic ware will last for years.

Fig. 2—Electrolytic cells at the plant of the Niagara Alkali Company

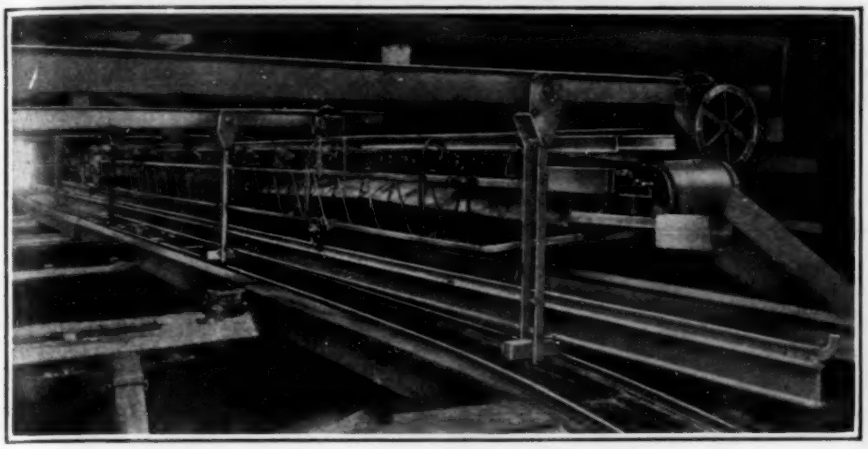


Fig. 3—Shuttle Conveyor for Handling Salt to Storage

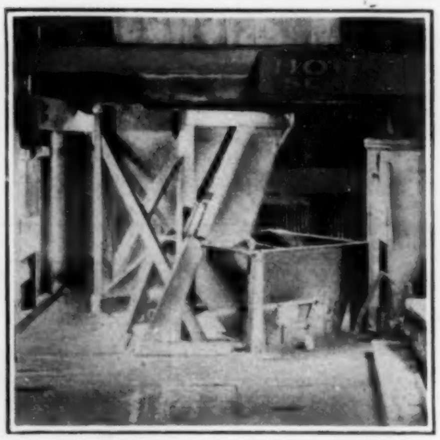


Fig. 4—Floating Weighing Hopper

Salt Handling Equipment

By J. Turner

Barber-Greene Co., Aurora, Ill.

The Independent Salt Company, Brooklyn, has an arrangement of handling equipment for the storage of salt received at the plant which is both simple an effective. It consists of a number of conveyors and a series of hoppers working in conjunction with a shuttle conveyor in such a manner that the salt, as unloaded, is weighed, recorded and routed to the proper storage bin at the rate of from 800 lb. to 1,50U lb. per minute. This is accomplished by only one operator through the use of a centralized control system.

The salt is received in barges from which compartment covers are removed and the salt elevated by means of a clam-shell bucket operating on a stiff-leg derrick to a hopper on the roof. This hopper is large enough to hold a number of bucket loads. It discharges through a gate into a smaller hopper shown in the center of Fig. 4. The latter hopper floats upon the scale shown at the right. The scale is permanently balanced for a net hopper content of 800 lb. The operator allows salt to discharge into the weigh-hopper until the scale beam rises, when he cuts off the supply and opens a gate in the bottom of the weigh-hopper. The action is registered on an operation recorder, thus keeping a continuous weight record of the salt unloaded. The salt flows from the hopper shown to another below, which distributes it to one of two permanent conveyors. The routing is controlled by levers operated from the weighing floor. One conveyor delivers the salt through a swiveling chute to the shuttle shown in Fig. 3, while the other conveys to emergency storage.

The shuttle is capable of being moved the length of the storage building on its own tracks, as well as the width of the building on the tracks from which it is suspended. By this means, each of the five main bins can be reached, although they are not in a straight line. The shuttle motor receives power through a flexible cable which is kept taut by means of a system of pulleys and counterweights. Through this series of devices a large tonnage of salt is thus handled with a minimum of labor.

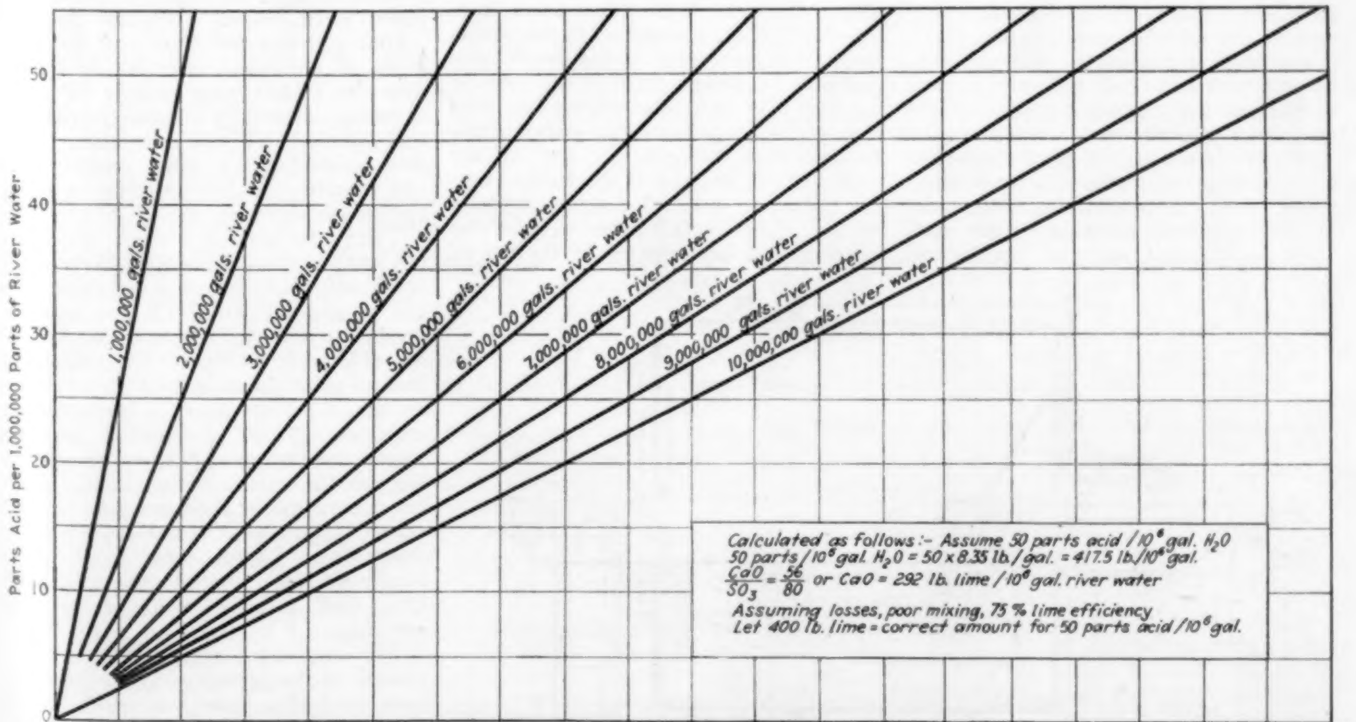
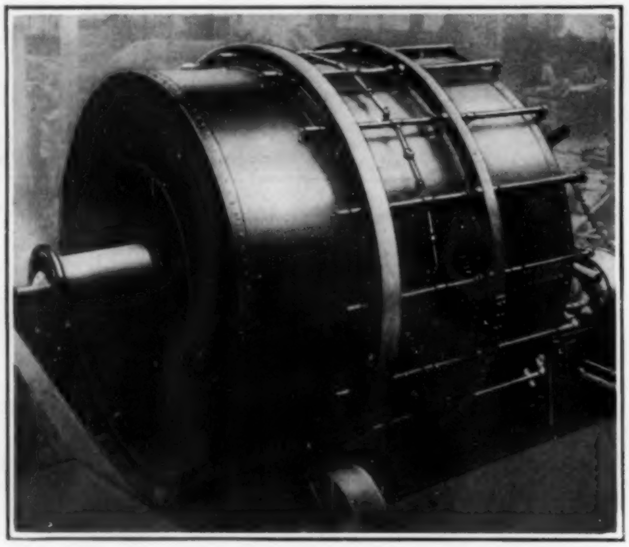


Chart for Determining Lime Required to Neutralize Acid Waters

This chart has proved extremely useful in the routine control of the neutralizing of acid waters for process and cooling purposes.

By L. G. Jones, *Baltimore, Md.*

EQUIPMENT NEWS *from* MAKER *and* USER



A Dorrco Filter Installation

Internal Drum Filter

One of the more recent developments in chemical engineering equipment is the Dorrco Filter manufactured by the Dorr Company, 247 Park Ave., New York.

The filter, while it operates in a manner analogous to the several other continuous rotary vacuum filters on the market, nevertheless has a distinct field of usefulness, it is claimed by the manufacturers. In reversing the usual procedure, the cake is formed on the inside of the drum and hence the filter requires no pulp tank and no agitating equipment to prevent the heavier particles of the pulp from settling out. For this reason also there is no possibility of the settled pulp stalling the machine after a shutdown. And in theory at least, the pulp, in settling before filtration grades itself with the coarsest material against the filter element resulting in a reduced tendency for the fines to clog the cloth.

The construction is evident from Fig. 1. The drum is adapted to rotate in a trunnion bearing at the valve end and upon a track and rollers at the open end. The filter clothes are applied to wire mesh backing in a number of panels disposed about the inside of the drum. The makers claim great ease in removing the filter elements from the open end. Vacuum and air are applied to the panels through a port valve at the closed end. Air may be sucked through the cake or the cake may be washed during that portion of the cycle until the panel under consideration reaches the top of the drum, when the cake is discharged into the hopper by a blast or series of blasts of air. With certain types of cake the cloth may be kept cleaner by the use of several discharging blasts, which vibrate the entire panel. A special air valve is supplied for this purpose. Material discharged is immediately conveyed out of the drum by a screw flight in the hopper bottom.

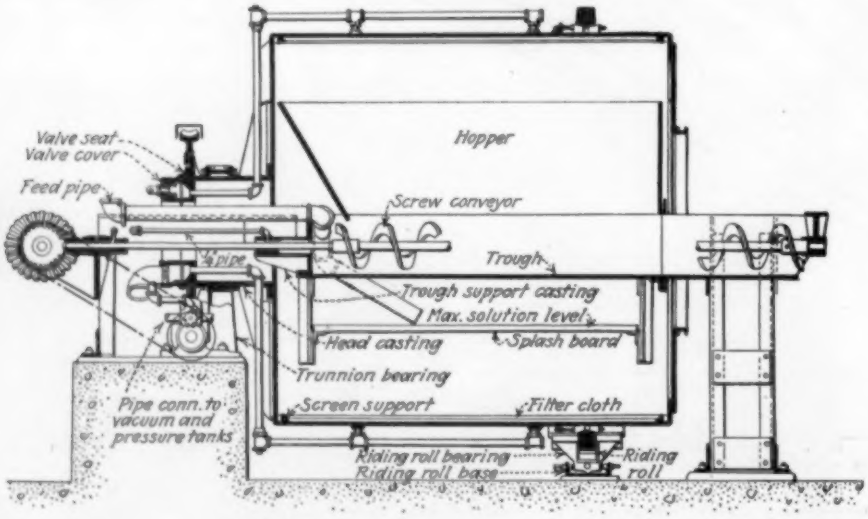


Fig. 1—Side Elevation of the Dorrco Filter

Mercury Detector

As small a proportion as one part of mercury in 20,000,000 parts of the atmosphere can be measured accurately by a device which has been developed in the research laboratory of the General Electric Co., Schenectady, N. Y.; one in 8,000,000 parts can be determined quickly.

Mercury poison is accumulative; it seems to make little if any difference whether the amount of vapor is inhaled as relatively large amounts in a short period of time, or as slight amounts over a period of months. Because of the increased industrial use of mercury in heating operations, in various chemical processes and in the newly developed mercury turbine, it has become important to have a method whereby leaks in apparatus and traces of mercury vapor in the atmosphere can be detected quickly.

Previous methods of determining the amount of mercury vapor in the atmosphere were tedious processes that required considerable time and the services of an expert chemist, and even then the results were usually far from accurate, especially when considering tiny amounts of the substance. The new method gives quick results, does not require chemical training to carry out, and is accurate.

The principle on which the new method is based is a reaction between a solid substance, selenium sulphide, and the mercury vapor, with the reaction product a colored substance easily observable with the eye. The yellow selenium sulphide is applied as a coating on paper. The paper is blackened on exposure to air containing mercury vapor, the degree of blackening depending on the concentration of the mercury, the time of exposure, and various other factors which can be definitely controlled. There seems to be practically no lower limit to the concentration that can be detected by this method.

For continuous and automatic registration of the mercury vapor, there has been devised a system in which a continuous strip of the coated paper is drawn slowly over an opening through which the air flows, a small clock motor moving the strip of paper at a uniform rate. A short time after the exposure,

the colored strip of paper can be compared with a standard scale, in which the different shades from yellow to black have been calibrated in terms of mercury concentration.

If an incandescent lamp is placed in front of the strip of paper and a photo-electric cell behind it, the amount of light reaching the cell will depend on the amount of blackening of the paper. The light can regulate the readings of an ammeter, so that the concentration of the mercury vapor can be determined either by observing the color of the paper or by reading the ammeter. It is also possible to so arrange the photo-electric cell circuit that, should the mercury concentration become dangerously high, a warning gong will be sounded. The apparatus is then an automatic chemist.

Variable Speed Transmission

The Stephens-Adamson Mfg. Co., Aurora, Ill., has recently added the J. F. S. Variable Speed Transmission to their list of products. This new device, which is no larger than the motor with which it is used, operates without gears, and is therefore noiseless. It is fully enclosed and the parts run continuously in oil. Transmission efficiency is said to be better than 95 per cent up to rated capacity. The machine has a maximum output speed of about 55 per cent of the input and a minimum of about 10 per cent. Sizes range from ½ to 15 hp. at full reduction.

The principle employed is shown in Fig. 2. The machine may be likened to a roller-bearing in that the power is transmitted through a planetary system in which double conical rollers replace gears. The manufacturers claim that transmission losses are no greater than those in a roller bearing under similar service.

The small shaft passing through the hand-wheel is connected through a flexible coupling or through other driving means to the power source. Through a coupling inside the casing, the power is transmitted to a central shaft upon which are keyed two disks of special shape slideably mounted and forced toward each other by heavy springs. These disks act as the inner roller race. The three rollers are so shaped as to make point contact with the inner race in all positions and similarly to make point contact with the stationary outer race. Through a hand-wheel and yoke the proximity of the two halves of the outer race may be continuously varied with limiting positions with respect to the rollers and inner race as shown at (A) and (B).

A yoke keyed to the larger driven shaft carries links which transmit the revolution of the rollers about the stationary race to the output side of the machine. It is evident that rotation imparted to the inner race is communicated as a differential revolution to the rollers and hence to the yoke. By varying the relation of the halves of the races, the contact points between races and rollers may be changed with a resultant variation in output speed.

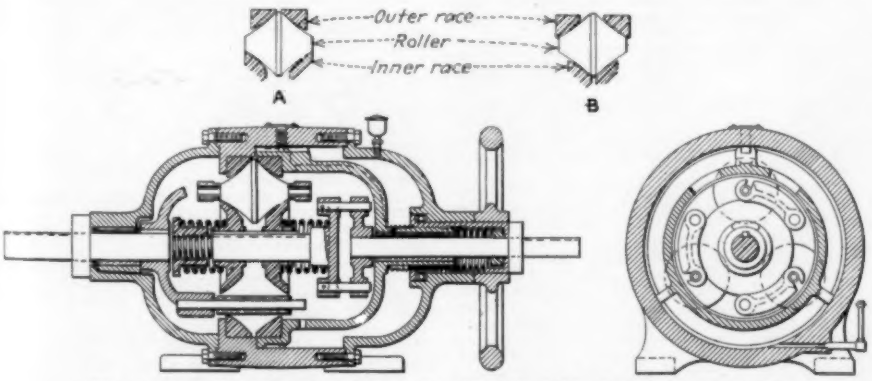


Fig. 2—Detailed Construction of the JFS Variable Speed Transmission

Panel Unit Air Filter

The Staynew Filter Corporation, Rochester, N. Y., has recently introduced a panel type industrial air filter intended to handle 800 c.f.m. per unit. Where more air is required, two or more units are used in parallel.

The panels are supported on angle iron frames, which may also be supplied in aluminum if desired. The cloth, which is specially treated to give a guaranteed filtering efficiency of 99.9 per cent, is arranged in a series of hollow fins supported on wire mesh.

It is stated by the manufacturers that the cloth requires cleaning ordinarily only once in six months and that this may then be done without removing it from the supporting bases by means of compressed air or a vacuum cleaner. The life of the clothes is further claimed to be from three to five years depending upon the service.

Drip Trap

Warren Webster & Company, Camden, N. J., have announced a new heavy duty drip trap for working pressures up to 10 lb. per sq.in. The trap is light and may be installed in the pipe line without other support. A thermostatic element is provided in the upper part of the housing for venting air to either the wet or dry return. Condensate is discharged through an outward opening, spherical seated valve which is controlled by a float. The trap is made only in the 1¼ in. size with condensation capacity up to 1,800 lb. of water per hour.

Mechanical Pyrometer

A new indicating mechanical pyrometer is being distributed by Horace Hills, Room 1535, 315 Montgomery St., San Francisco. The instrument is supplied in both high and low range and is adapted to screw directly without the use of a thermometer well into the vessel of which the temperature is to be measured.

The pyrometer was originally developed to determine the exhaust temperature of high-powered Diesel engines. It is claimed that the instrument is so sensitive that when used in the exhaust of a slow-running Diesel, the pointer will deflect at each exhaust valve opening.

Great durability and freedom from permanent distortion of the thermal element are claimed. The parts are kept in continual contact by spring pressure and are therefore free from backlash. Vibration, as a consequence is said to have no effect on the accuracy.

Compressor Unloader

The Chicago Pneumatic Tool Co., 6 East 44th Street, New York, N. Y., has recently developed a differential unloader for use with their compressors, called the "Simplate." The valve is a single plate of stainless steel ground to a flat surface. The diameter is ground to fit the cap with a very small clearance, the edge being rounded to prevent sticking as a result of cocking on the seat. The cap contains a ball check valve, spring and a small check screw. The flanges by which the unloader is attached to the compressor or panel are on the cap. This permits dismantling the unloader for examination or cleaning without disturbing the piping or valve.

The device operates with a 5 lb. range between unloading and loading. An unloader is set to unload generally with 100 lb. and the reloading pressure is 5 lb. lower. As the air pressure rises to 100 lb., the pressure on the upper side of the valve balances the spring on the under side and air escapes past the seat into the annular space around the outer edge of the disk. Because of the close fit of the disk in the cap and the small check valve, the air cannot escape and a slight pressure is built up which acting upon the surface of the disk balances the pressure of the spring on the lower side and the disk moves down against its seat. The ball check valve is then exposed to the full receiver pressure and being held on its seat by a very light spring immediately moves off and uncovers a quarter-inch hole for air to pass through on its way to the unloading inlet valves.

Upon a drop of pressure equal to the range, 5 lb., the pressure of the spring balances the pressure due to the air on the disk and causes it to permit leakage past the lower seat into the space around the stem. This leakage is restricted slightly by the upper spring holder which is a moderately close fit in the body and a slight over-balancing pressure is built up which causes the valve disk to return to the upper seat with a positive movement and the air is vented from the unloading pipe past the upper spring holder.

This unloader is built for standard pressures from 50 to 125 lb.; for low pressure work of 40 lb., or less; and for high pressure work up to 500 lb. One of the outstanding advantages claimed for this device is the large quantity of air that it allows to pass through it without interfering with its operation. Enough air is passed for unloading the largest compressors without the use of auxiliary unloaders.

Filter-type Thickener

The United Filters Corporation, Hazleton, Pa., has introduced a new piece of equipment known as the Sweetland Thickener. A detail of the construction is given in Fig. 3.

The new thickener is adapted to the partial dewatering of all dilute pulps and slimes which are settled with difficulty. The principal use to date has been in connection with the beet sugar industry although the manufacturers claim general applicability of the apparatus throughout the chemical engineering and metallurgical industries.

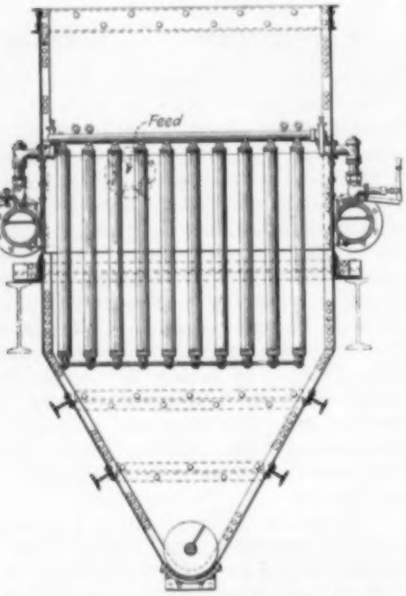


Fig. 3—Section of a Sweetland Thickener

Briefly, the thickener consists of a rectangular tank with a V-shaped bottom in which is located a right and left-hand flight direct motor-driven scroll for discharging the thickened material through a valve at the center. In the upper part of the tank are suspended a number of tubular filter elements mounted upon a series of header pipes which individually and alternately connect through shut-off valves and sight glasses to two manifolds which in turn communicate with a wet vacuum pump. An overflow is provided to regulate the liquor height and the feed is baffled to prevent the influx of fresh material from desturbing the deposited cake.

In operation the wet vacuum pump is run for a predetermined length of time until a cake of sufficient thickness has been deposited on the filter elements. Then, through the action of an automatic reversing switch, the pump is reversed, causing the cake to be discharged from the tubular elements. The thickened material settles to the bottom where it is continuously removed from the thickener by means of the flights.

Manufacturers' Latest Publications

Esterline-Angus Company, Indianapolis, Ind.—Circular No. 52—A folder pointing out the savings frequently to be made through the use of power demand surveys.

Hays Corporation, Michigan City, Ind.—A folder on "Trouble Shooting in Heating Plants" through investigation of draft and flue gas composition and temperature.

Central Scientific Company, Chicago, Ill.—Catalog C-227—A general catalog of chemical and biological laboratory apparatus.

Pyrometer Instrument Company, 74 Reade Street, New York, N. Y.—Bulletin No. 20—Folder showing the operation and use of the Pyro Radiation Pyrometer.

Foxboro Company, Inc., Foxboro, Mass.—Folders DMF 524 and DMF 540—describing respectively, combustion control meters and psychrometers.

Republic Flow Meter Company, Chicago, Ill.—Circular showing types of indicating and recording CO_2 meters.

W. E. Caldwell Company, Louisville, Ky.—Catalog No. 38—1927 edition of this company's catalog of wood and steel tanks and towers.

Hauser-Stander Tank Company, Cincinnati, Ohio—A new handbook on wooden tanks.

Fusion Welding Corporation, 130 St. & Torrence Ave., Chicago, Ill.—A booklet describing the service and some of the equipment offered by this company for arc welding.

G. & G. Atlas System, 537-9 West Broadway, New York, N. Y.—Several new pamphlets on the uses of pneumatic dispatch tubes in industry.

General Electric Company, Schenectady, N. Y.—New leaflets as follows: GEA-6A, 3-Phase "500 Series" squirrel-cage motors; GEA-59, Enclosed heavy duty starting rheostats; GEA-98, single-phase adjustable varying speed motors; GEA-164B, metal-melting pots and equipment; GEA-246A, "7500 series" general purpose synchronous motors; GEA-267, starting switches for small induction motors; GEA-360A, remote indicating speed controller for A.C. slip-ring induction motors; GEA-707, modernizing mine locomotives; GEA-712, Type BTA motors for adjustable speed service with alternating current; GEA-787 Vertical "500 Series" induction motors; GEA-795, air compressor governors; GEA-801, oil tempering baths; GEA-808, "500 Series" totally enclosed induction motors; GEA-811, A.C. jack type disconnecting switches; GEA-812, air heating units.

Worthington Pump & Machinery Corporation, 115 Broadway, New York, N. Y.—Bulletin S-173—A booklet describing the new Worthington double-acting two-cycle Diesel engine.

Bethlehem Steel Company, Bethlehem, Pa.—Catalog F describing type S Diesel engines for stationary service.

Cleveland Crane & Engineering Company, Wickliffe, Ohio.—Form No. TR 552—A leaflet concerning the Cleveland tramrail system as applied in various industries.

Louisville Cement Company, Louisville, Ky.—Brixment Handbook—describes the uses and properties of Brixment, a masons' cement.

Crouse-Hinds Company, Syracuse, N. Y.—New literature as follows: Advance sheet No. 93—Vapor-proof lighting fixtures.—Folders Nos. 44 and 45—describing and showing the applications of the "LCE" Floodlight Projector.

Celite Products Company, 11 Broadway, New York, N. Y.—Bulletin 107—describing the use of Sil-O-Cel bricks, and powder and various cements for heat insulation in iron and steel plants.

Linde Air Products Company, 30 East 42nd Street, New York, N. Y.,—"Oxwelded Roof Trusses." A monograph on the comparison of riveted Fink trusses with several trusses employing different types of welded construction.

Connersville Blower Company, Connersville, Ind.—Bulletin 19-E—Showing the application and construction details of the cycloidal rotary pump.

United Filters Corporation, Hazleton, Pa.—Bulletin 140—A detailed description of the new Sweetland filter-type thickener is given.

Bethlehem Foundry & Machine Company, Bethlehem, Pa.—Bulletin F-14—describing the application of the Wedge Mechanical Furnace to the revivification of Fullers' earth in the petroleum refining industry.

Nichols Copper Company, New York, N. Y.—Bulletin 200—This is a booklet giving very complete information on the Nichols Herreshoff Furnace.

Deister Concentrator Company, Fort Wayne, Ind.—Bulletin 18—A description of the No. 6 Deister-Overstrom Diagonal Deck Sand or Slime Table.

Century Electric Company, St. Louis, Mo.—Forms No. 650 and 651—Folders giving details of construction of the "Century" Single Phase Motor.

Staynew Filters Corporation, Rochester, N. Y.—Form 108-A—describing Protectomotor Industrial Air Filters for a wide range of uses. Two new types, one a panel unit for filtering large volumes of air, and the other adapted for installation in compressed air lines, are announced.

H. O. Swoboda, Inc., 3400 Forbes St., Pittsburgh, Pa.—Bulletin 108—A description of an electrically heated asphaltum coating tank.

Thyle Machinery Company, San Francisco, Calif.—Bulletin 30—gives a complete description and explanation of the Bradley Underflow Density Control Valve.

Merco Nordstrom Valve Company, 121 Second St., San Francisco, Calif.—New pamphlet featuring the uses of lubrication valves in the chemical industries.

Warren Webster & Company, Camden, N. J.—Bulletin 712 announces a new heavy duty, light weight drip trap.

Crown Metal Company, 253 Washington St., Milwaukee, Wis.—A leaflet containing data on block tin and lead pipe, and sheet lead.

International Nickel Company, 67 Wall St., New York, N. Y.—Bulletins 203 and 204, covering respectively, the economic value and the effect on machinability of nickel in cast iron. Also two new leaflets describing the use of nickel in connection with the Wright "Whirlwind Motor" and the "Duesenberg Racing Car."

American Blower Company, Detroit, Mich.—Bulletin 1028—describing the collection of fly-ash and coal dust with the Sirocco type D Collector.

Gillis & Geoghegan, 535 West Broadway, New York, N. Y.—Catalog 2537—describing telescopic and non-telescopic hoists, manually and electrically driven.

Link-Belt Company, Philadelphia, Pa.—Book No. 715—describing the new Link-Belt Sykes Herringbone Speed Reducer.

Chas. Cory & Son, Inc., 185 Varick St., New York, N. Y.—Bulletin 201-29-C—covering a variety of types of flexible metal hose.

Webster Mfg. Company, Chicago, Ill.—Catalog 50—Price list and description of chains and sprockets.

Rotor Air Tool Company, Cleveland, Ohio.—Catalog describing Rotor pneumatic grinders and drills.

Duriron Company, Dayton, Ohio.—New leaflet on the handling of muriatic acid from tank cars in Duriron equipment.

Combustion Engineering Corporation, 200 Madison Ave., New York, N. Y.—Two recent reprints describing the Buck and Lauderdale Steam Power Stations.

Clement K. Quinn & Company, Duluth, Minn.—1927 analyses of Lake Superior iron ores.

Century Electric Company, St. Louis, Mo.—Folder 652—Folder on the repulsion start, induction, single phase motor.

Witt-Humphrey Steel Company, Greensburg, Pa.—New catalog describing the uses and application of the MetaLayer process of material coating.

PATENTS ISSUED

September 6 to 27, 1927

Paper, Pulp and Sugar

Process of Treating Paper. Dozier Finley, Berkeley, Calif., assignor to The Paraffine Companies, Inc., San Francisco, Calif.—1,641,478.

Method of Treating Paper Board. Dozier Finley, Berkeley, Calif., assignor to The Paraffine Companies, Inc., San Francisco, Calif.—1,641,479.

Method of and Apparatus for Creping Paper. Austin E. Cofrin, Green Bay, Wis. —1,641,739.

Paper Machine and Method of Making Paper. Nickolas J. Niks, Chillicothe, Ohio. —1,641,987.

Truing Lathe for Wood-Pulp Grinders. John James Warren, Brownville, N. Y.—1,642,053.

Composition for Treating Products of Fiber and Method of Making Same. Charles R. Felix, Hatfield, Pa.—1,643,116.

Self-Supporting Lining for Jordan-Engine Shells. Archer Le Roy Bolton, North Andover, Mass., assignor to John W. Bolton and Sons, Inc., Lawrence, Mass.—1,643,368.

Controller. Darcy E. Lewellen and Emmons F. Lewellen, Columbus, Ind.—1,643,716.

Process for Making Paper Pulp. Bertrand S. Summers, Port Huron, Mich.—1,643,826.

Rubber and Synthetic Plastics

Process for Treating Latex and Products Obtained Thereby. Sidney M. Cadwell, Leonia, N. J., assignor to The Naugatuck Chemical Company, Naugatuck, Conn.—1,641,573.

Process of Reclaiming Rubber. George J. Miller, Douglas, Ariz.—1,641,598.

Rubber Conversion Product and Method of Making Same. Harry L. Fisher, Akron, Ohio, assignor to The B. F. Goodrich Company, New York, N. Y.—1,642,018.

Synthetic Resin and Method of Making Same. James McIntosh and Edwin Yeakle Wolford, Norristown, Pa., assignors to Diamond State Fibre Company, Elsmere, Del.—1,642,078.

Synthetic Resin and Method of Making Same. James McIntosh, Norristown, Pa., assignor to Diamond State Fibre Company, Bridgeport, Pa.—1,642,079.

Resin-Containing Coating Composition. Johannes M. Kessler, West Orange, N. J., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,642,155.

Production of Vulcanized Rubber and Accelerators Therefor. Harold Walter Elley and Donald Howard Powers, Wilmington, Del., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,643,205.

Method of Improving Aldehyde Resins. Willy O. Herrmann, Hans Deutsch, and Wolfram Haehnel, Munich, Germany, assignors to Consortium für Elektrochemische Industrie G. m. b. H., Munich, Bavaria, Germany.—1,643,496.

Plastic Composition. Charles S. Reeve, Grantwood, N. J., assignor to The Barrett Company.—1,643,520.

Plastic Composition. Charles S. Reeve, Grantwood, N. J., assignor to The Barrett Company.—1,643,521.

Petroleum Refining

Process of Distilling Oil in Presence of Comminuted Carbonaceous Fuel. Walter Edwin Trent, Washington, D. C., assignor to Trent Process Corporation, Washington, D. C.—1,641,305.

Refining Hydrocarbon Oils. Paul McMichael, Flushing, N. Y., assignor to The Hydrocarbon Refinishing Process Co., Inc., New York, N. Y.—1,641,546.

Process for Breaking Petroleum Emulsions. Melvin De Groote, St. Louis, and Wilbur C. Adams, University City, Mo., assignors to Wm. S. Barnickel & Company, Webster Groves, Mo.—1,641,804.

Apparatus for Cracking Hydrocarbons. John E. Bell, deceased, Brooklyn, N. Y., by Lola R. Bell, executrix, Brooklyn, N. Y., and Edward W. Isom, Locust Valley, N. Y., assignors to Sinclair Refining Company, New York, N. Y.—1,641,941.

Process for Manufacturing Light Hydrocarbon Liquids. Willis S. Yard and Earl Newman Percy, Oakland, Calif.—1,643,401.

Process and Apparatus for the Conversion of Heavy Petroleum Oils into Lighter Oils. Vernon W. Northrup, Hurlock, Md., assignor to The Petroleum Hydrogenation Company of America, Incorporated, Wilmington, Del.—1,642,624.

Method of and Apparatus for Treating Hydrocarbons. Charles P. Tolman, Kew Gardens, N. Y.—1,643,036.

Process of Refining Mineral Oils. Theodor Hellthaler, Granschutz, Germany, assignor to the Firm: Hugo Stinnes Riebeck Montan und Ölwerke Akt. Ges., Halle-on-the-Saale, Germany.—1,643,272.

Process for Treating Petroleum Hydrocarbons. Walter M. Cross, Kansas City, Mo., assignor to Gasoline Products Company, New York, N. Y.—1,643,446.

Combustion and Furnaces

Gas Burner. Paul C. Hughes, Tulsa, Okla.—1,641,274.

Burner. Paul C. Hughes, Tulsa, Okla.—1,641,275.

Pulverized-Coal System. John E. Bell, Brooklyn, N. Y., assignor to Combustion Engineering Corporation, New York, N. Y. —1,641,470.

Smoke-Treating Apparatus. Carl J. Schobrone, Cleveland, Ohio.—1,641,995.

Carburetor. Dan C. Hendrickson, Wichita Falls, Tex., assignor of one-half to Walter K. Campbell and one-half to L. D. Baird, Tulsa, Okla.—1,643,711.

Organic Processes

Soapy Emulsion of Bitumen Suitable for Paving and Method of Making the Same. William T. Headley, Philadelphia, Pa.—1,640,544.

Condensation-Product Varnish. Arthur L. Brown, East Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Company.—1,640,562.

Treatment of Fabrics, Paper and Other Materials. Robert H. Chatham, Manchester, England, assignor to Celanese Corporation of America.—1,640,596.

Manufacture of Borneol Esters. Henri Blum, Mulhouse, France, assignor to Société Alsaciens de Produits Chimiques, Parsi, France.—1,640,639.

Acceleration of Gelatinization of Cellulose Nitrate. Robert C. Moran, Woodbury, N. J., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,640,712.

Manufacture of Large-Grained Dextrose. William B. Newkirk, Riverside, Ill., assignor to International Patents Development Company, Wilmington, Del.—1,640,717.

N-Dihydro-Dianthraquinone-Azine Compounds and Process of Making Same. John H. Sachs, Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,640,724.

Nitration Process and Nitrating Mixture Therefor. Guy B. Taylor, Wilmington, Del., and Albert S. Richardson, Cincinnati, Ohio, assignors to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,640,737.

Production of Complex Aurothio-Sulphate Compounds. Einar Keiding, Birkerod, and Johannes Keiding, Charlottenlund, Denmark.—1,640,775.

Process for the Manufacture of Condensation Products of Crotonaldehyde. Walter Kropp, Elberfeld, near Cologne-on-the-Rhine, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,640,899.

Process for the Manufacture of Active Carbon. John Nicolaas Adolf Sauer, Amsterdam, Netherlands.—1,641,053.

Process for Producing Active Carbon. Paul Lueg, Leverkusen, Julius Drucker, Cologne-Muhlheim, and Heinz Thienemann, Leverkusen, near Cologne, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,641,281.

Manufacture of Nitrated Cellulose from Wood Pulp. Victor Planchon, Lyon, France.—1,641,292.

Process for the Production of Filmlike Bands from Cellulose Solutions and Similar Initial Materials. Emil Czapek and Richard Weingand, Bomlitz, near Walsrode, Germany.—1,641,322.

Cellulose-Acetate Composition. Stewart J. Carroll, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y.—1,641,411.

Cellulose-Acetate Composition. Stewart J. Carroll, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y. —1,641,412.

Cellulose-Acetate Composition of Low Inflammability. Stewart J. Carroll, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y.—1,641,413.

Motor Fuel. Harry P. Bassett, Cynthiana, Ky.—1,641,520.

Pyroxylin-Lacquer Composition. Bruce K. Brown and Charles Bogin, Terre Haute, Ind., assignors to Commercial Solvents Corporation, Terre Haute, Ind.—1,641,529.

Manufacture of Alcohols. Robert B. MacMullin and Ralph E. Gegenheimer, Niagara Falls, N. Y., assignors to The Mathieson Alkali Works, Inc., New York, N. Y.—1,641,544.

Manufacture of Synthetic Camphor by Means of a Liquid Catalyst. Léon Darrasse and Etienne Darrasse, Paris, and Lucien Dupont, Vincennes, France.—1,641,579.

Method of and Means for Manufacturing Artificial Silk. Martin Hölken, Jr., Barmen, Germany.—1,641,588.

Process of Preparing Glycols. Frederick H. Untiedt, Washington, D. C.—1,641,710.

Process for the Production of Glucose from Materials Containing Cellulose. Ludolf Meiler and Heinrich Scholler, Munich, Germany.—1,641,771.

Treatment of Cellulose Derivatives. George Holland Ellis, Spondon, near Derby, England, assignor to Celanese Corporation of America.—1,641,965.

Process for Treating Animal Tissues and Products Obtained Therefrom. Friedrich W. Weber, Hackensack, N. J.—1,642,054.

Di-Para-Xylylguanidine. Winfield Scott, Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del. —1,642,180.

Process for Manufacturing Dinitro Perylene Quinone. Alois Zinke, Graz, Austria, assignor, by mesne assignments, to Felice Bensa, Genoa, Italy.—1,642,263.

Artificial Leather. Royal K. Abbott, Cranston, R. I., assignor to Respro Inc., Providence, R. I.—1,642,394.

Method of Preparation of Methyl Formate. Martin Mugdan and Joseph Wimmer, Munich, Germany, assignors to Consortium für Elektrochemische Industrie, Munich, Germany.—1,642,689.

Preparation of Cyanogen Compounds. Robert W. Poindexter, Jr., Los Angeles, and William Earl Olberg, Long Beach, Calif., assignors to California Cyanide Company, Incorporated, New York, N. Y. —1,642,694.

Pharmaceutical Product Containing Arsenic and Process of Making Same. Walter Schoeller and Max Gehrke, Berlin, Germany, assignors to Firm: Chemische Fabrik auf Actien (vorm. E. Schering), Berlin, Germany.—1,642,830.

Clarifying and Decolorizing Agent and Process for Making the Same. Marvin L. Chappell, Richard F. Davis, and Merle M. Moore, El Segundo, Calif., assignors, by mesne assignments, to Contact Filtration Company, San Francisco, Calif.—1,642,871.

Chromiable Brown Disazo Dyestuffs. Wilhelm Neelmeier, Leverkusen, Theodor Nocken, Wiesdorf, near Cologne-on-the-Rhine, and Werner Rebner, Cologne-Mulheim, Germany, assignors to Grasselli Dyestuff Corporation, New York, N. Y.—1,643,222.

Dyeing and Printing with Phenylamine Black. Guillermo Aris, Barcelona, Spain.—1,643,233.

Purified Rosin and Process of Producing the Same. William Burns Logan, De Quincy, La., assignor to Acme Products Company, Inc., New Orleans, La.—1,643,276.

Cyclohexyl Phthalates and Process of Making Same. Ebenezer Emmett Reid and George L. Schwartz, Wilmington, Del., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,643,393.

Anthraquinone - Nitrosamine Compound. Heinrich Tesche and Albert Job, Elberfield, near Cologne, Germany, assignors to Grasselli Dyestuff Corporation, New York, N. Y. —1,643,428.

Process for the Production of New Ester Mixtures. Walther Claasen, Cologne-on-the-Rhine, Germany.—1,643,619.

Production of Methane. Fritz Klatte and Julius Söll, Schwanheim-on-the-Main, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,643,663.

Art of Treating Molasses and Product Resulting Therefrom. Jesse H. Leftwich, Chicago, Ill.—1,643,666.

Bituminous Emulsion. John Alexander Montgomerie, Glasgow, Scotland.—1,643,675.

Salts Composed of Alkaloids and Acetylamino-Hydroxyphenyl Arsenic acid and Method of Preparing the Same. Francois Billon, Paris, France, assignor to Les Etablissements Poulenc Frères, Paris, France.—1,643,692.

Process of Manufacturing Vanillin. Richard H. Bots, Syracuse, N. Y.—1,643,804.

Process of Manufacturing Vanillin. Richard H. Bots, Syracuse, N. Y.—1,643,805.

Inorganic Processes

Method of and Apparatus for Condensing Aluminum Chloride. George L. Prichard and Herbert Henderson, Port Arthur, Tex., assignors to Gulf Refining Company, Pittsburgh, Pa.—1,641,503.

Process for Manufacture of Precipitated Calcium Carbonate. Burton G. Wood, Los Angeles, Calif., assignor to Ivannah Lime and Chemical Company, Los Angeles, Calif.—1,641,563.

Oxidation-Resisting Material. Rudolph F. Flintermann, Detroit, Mich., assignor, by mesne assignments, to General Electric Company.—1,641,752.

Process of Making Sodium Phosphates. Henry Howard, Cleveland, Ohio, assignor to The Grasselli Chemical Company, Cleveland, Ohio.—1,642,244.

Process for the Production of a Weatherproof Oxide Layer on Electron Metal. Willy Pieper, Nuremberg, Germany, assignor to J. B. Soellner Nachf, Reisszeugfabrik A.-G., Nuremberg, Germany.—1,642,309.

Method of Treating Lead Dross. Oliver Perry Chisholm, Durango, Colo., assignor to American Smelting and Refining Company, New York, N. Y.—1,642,358.

Fungicide Containing Copper and Method of Making the Same. John D. Jenkins and Eugene F. Berger, Milwaukee, Wis., assignors to Pittsburgh Plate Glass Company.—1,642,370.

Process of Making Sodium Sulphites and Boric Acid. Henry Blumenberg, Jr., Moapa, Nev., assignor to Stockholders Syndicate, Los Angeles, Calif.—1,642,535.

Process for Decomposing Insoluble Minerals. Godskalk Berge, Chicago, Ill., assignor of one-third to Harry Spurrier, Chicago, Ill.—1,642,667.

Apparatus for Production of Pure Metal. Samuel L. Madorsky, Chicago, Ill., assignor to Gathmys Research Corporation, Chicago, Ill.—1,642,683.

Process for Making Ammonium Fluorides. James William Proctor, Belle Vernon, Pa., assignor to General Chemical Company, New York, N. Y.—1,642,788.

Manufacture of Precipitated Zeolites. Heinrich Kriegsheim, New York, and William Vaughan, Brooklyn, N. Y., assignors to The Permutit Company, New York, N. Y.—1,642,880.

Manufacture of Fluorides. Fritz Sander, Griesheim-on-the-Main, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,642,896.

Process of Manufacturing Cementitious Material. Henry S. Spackman, Ardmore, Pa.—1,643,136.

Hydraulic Cement and Process of Making the Same. Henry S. Spackman, Lehman Township, Pike County, Pa.—1,643,137.

Unburned Refractory Brick. George K. Schlotterer, Chester, and Robert H. Youngman, Pittsburgh, Pa., assignors to Harbison-Walker Refractories Company, Pittsburgh, Pa.—1,643,181.

Conversion of Lead Chloride to Lead Carbonate. Stanley Cochran Smith, London, England.—1,643,261.

Silver-Silicon Alloy and Process of Making the Same. Michael G. Korsunsky, Jackson Heights, N. Y., now, by judicial change of name, Michael George Corson, assignor to Electro Metallurgical Company.—1,643,304.

Process for Recovering Metals from Slag. Fred Rosenzweig, Pittsburgh, Pa.—1,643,610.

Process of Precipitating Copper from Sulphate Solution. Niels C. Christensen, Salt Lake City.—1,643,922.

Chemical Engineering Equipment and Processes

Centrifugal Apparatus. Joseph Martin Schutz, Chicago, Ill., assignor, by mesne assignments, to Centrifix Corporation, Cleveland, Ohio.—1,639,538.

Sugar-Mill Machinery. George I. Theile, Hamilton, Ohio, assignor to The Hooven, Owens, Rentschler Company, Hamilton, Ohio.—1,640,060.

Apparatus for Filtering and Purifying Liquids. Charles H. Perry, Miami, Fla.—1,640,249.

Apparatus for Condensing Milk. Richard M. Garrett, Yonkers, N. Y., assignor to Nestle's Food Company, New York, N. Y.—1,640,271.

Device for Indicating and Recording the Specific Gravity of Gases. Otto Dommer, Karlsruhe, Germany.—1,640,313.

Grading Apparatus. Norris G. Morgan, Galva, Ill.—1,640,365.

Means for Detecting Metal Particles in Non-Metallic Material. Roy Wilbert Augustine, Oak Park, Ill., assignor to Western Electric Company, Incorporated, New York, N. Y.—1,640,524.

Pneumatic Material Conveyer. George Bernert, Milwaukee, Wis.—1,641,149.

Float-Controlled Valve. John H. Stockholder, New Orleans, La.—1,641,240.

Automatic Measuring Valve. Fred M. Gunn, El Paso, Tex.—1,641,267.

Drier. Gustav Komarek, Chicago, Ill., assignor to Malcolmson Engineering and Machine Corporation, St. Louis, Mo.—1,641,337.

Hydrator. Hugh Miscampbell, Duluth, Minn.—1,641,347.

Grinding and Drying Apparatus. John E. Bell, Brooklyn, N. Y., assignor to Combustion Engineering Corporation.—1,641,409.

Continuous-Freezing Apparatus. Wilbert A. Heyman and William McComb, New York, N. Y.—1,641,429.

Mechanism for Operating Reciprocating Conveyers or Screens. Richard S. Jacobsen, Wheaton, Ill.—1,641,435.

Conveyer. John G. Jones, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y.—1,641,437.

Pulverizing Apparatus. William J. A. London, Hartford, Conn., assignor to International Combustion Engineering Corporation.—1,641,445.

Separation of Solids from Liquids. Scott Symington, Passaic, N. J.—1,641,708.

Apparatus for Gas-Treating Articles. Albin H. Warth, Baltimore, Md., assignor to The Crown Cork & Seal Company of Baltimore City, Baltimore, Md.—1,641,712.

Apparatus for Filtration. Niels C. Christensen, Salt Lake City, Utah.—1,641,736.

Sampling Apparatus and System. Clarence G. Dresser, St. Francois, Mo., and Floyd S. Youtsey, Collinsville, Ill.—1,641,748.

Crusher. Ray C. Newhouse, Wauwatosa, Wis., assigner to Allis-Chalmers Manufacturing Company, Milwaukee, Wis.—1,641,776.

Apparatus for Separating Liquids of different Specific Gravity. Thomas Fisher, Philadelphia, Pa., assignor to Fisher Engineering Corporation, Baltimore, Md.—1,641,843.

Machine for Making a Rubberized Fibrous Composition. Paul Beebe, Akron, Ohio, assignor to The Goodyear Tire & Rubber Company, Akron, Ohio.—1,642,008.

Steam Trap. Theodore Haight, Brooklyn, N. Y.—1,642,023.

Process of Briquetting Fuel. Park E. Welton and George H. Wadsworth, Akron, Ohio, assignors to The P. E. Welton Engineering Company, Akron, Ohio.—1,642,055.

Art of Obtaining Products from Sludge. Louis Burgess, Bayonne, N. J., assignor to Standard Development Company, New York, N. Y.—1,642,060.

Carboy Package. Hugh Harry Jones, Camden, N. J., assignor to General Chemical Company, New York, N. Y.—1,642,072.

Process and Material for Sterilization of Liquids. Arthur Schreier, Vienna, Austria, assignor, by mesne assignments, to General Zeolite Company, Chicago, Ill.—1,642,089.

Pulverizer. Charles E. Brainard, Chicago, Ill.—1,642,139.

Apparatus for Sewage Treatment by Activated Sludge in Combination with Sludge Digestion. Karl Imhoff, Essen, Germany.—1,642,206.

Plating and Method of Accomplishing the Same. Henry Gardner, Detroit, Mich., assignor to Ford Motor Company, Highland Park, Mich.—1,642,238.

Cylindrical Drier. Charles H. Crowell, White Plains, N. Y.—1,642,361.

Motor-Controlled Valve. Otto Thiel, Detroit, Mich., assignor to Silent Automatic Corporation.—1,642,391.

Method of Curing Rubber Articles. Robert R. Jones, Akron, Ohio.—1,642,614.

Tumbling Mill. Harry W. Titgen, Philadelphia, Pa.—1,642,632.

Centrifugal Apparatus and Process for Continuously Separating Liquids from Solids. Hans C. Behr, Scarsdale, N. Y.—1,642,662.

Method of Thickening Mixtures. Albert Legrand Genter, Salt Lake City, Utah, assignor, by mesne assignments, to Genter Thickener Company.—1,642,673.

Stone Catcher for Beet Slicers. Howard Ray Tuttle, Blissfield, Mich.—1,642,705.

Subliming Apparatus. Edwin H. Wedekind, San Francisco, Calif.; H. C. Haas administrator of said Edwin H. Wedekind, deceased.—1,642,756.

Concentrating Table. William F. Deister and Emil Deister, Fort Wayne, Ind., assignors to Deister Machine Company, Fort Wayne, Ind.—1,642,843.

Indicator for Low Liquid Levels. Frederick G. Folberth and William M. Folberth, Cleveland, Ohio.—1,642,848.

Kiln Car. George D. Morris, New Castle, Pa., assignor to American Dressler Tunnel Kilns, Inc., Cleveland, Ohio.—1,642,938.

Substance and Process for Using the Same for Refrigeration Purposes. Willis H. Carrier, Essex Fells, N. J., assignor to Carrier Engineering Corporation, Newark, N. J.—1,642,942.

Substance and Process of Using the Same for Refrigerating Purposes. Willis H. Carrier, Essex Fells, N. J., assignor to Carrier Engineering Corporation, Newark, N. J.—1,642,943.

Stopcock Having Floating Plug. Marion R. Shipley, Manhattan Beach, Calif., assignor, by mesne assignments, to Oil Appliance Manufacturing Corporation, Los Angeles, Calif.—1,642,973.

Method of Manufacturing Iron Oxide. Henry Carlisle Stewart, Philadelphia, Pa., assignor to The Westmoreland Chemical & Color Company, Philadelphia, Pa.—1,642,975.

Filtering Medium and Process of Making Same. Robert N. Riddle, Philadelphia, Pa., assignor to Riddle Process Company Inc., a Corporation of New York.—1,643,031.

Process of Making a Filtering Medium. Robert N. Riddle, Germantown, Pa., assignor to Riddle Process Company, Inc., a Corporation of New York.—1,643,032.

Method of Drying Yeast. Arnold K. Balls, Philadelphia, Pa.—1,643,047.

Drying Apparatus. Abraham B. Cibel, Brookline, Mass., assignor to Boston Dye House, Inc., Malden, Mass.—1,643,056.

Concentrating Table. William F. Deister and Emil Deister, Fort Wayne, Ind., assignors to Deister Machine Company, Fort Wayne, Ind.—1,643,060.

Process of Forming Colloid Products. Samuel A. Neidich, Edgewater Park, N. J.—1,643,080.

Automatic Pressure-Controlled Valve. Charles H. Nickell, Los Angeles, Calif.—1,643,082.

Gas-Analysis Apparatus. Robert Eisenschitz, Friedenau, Berlin, Germany, assignor, by mesne assignments, to Bailey Meter Company.—1,643,155.

Refrigerating System. Albert F. Sawyer, Haverhill, Mass., assignor to Irving L. Keith, Haverhill, Mass.—1,643,179.

Apparatus for Effecting Chemical Tests and Controlling Chemical Reactions. Henry Stafford Hatfield, London, England.—1,643,243.

Shipping Drum. Harold E. McCrery, Apollo, Pa., assignor to Pittsburgh Steel Drum Company, Pittsburgh, Pa.—1,643,252.

Valve. James D. Lalor, Baltimore, Md., assignor to The Lalor Fuel Oil System Company, Inc., Baltimore, Md.—1,643,305.

Method of and Apparatus for Coating. Paul J. Barord, Dormont Borough, Pa.—1,643,330.

Centrifugal-Separator Basket. Walter J. Blanchard, Cleveland, Ohio.—1,643,441.

Process for Bleaching and the Like Purposes. Carl Busch Throne, Hawkesbury, Ontario, Canada.—1,643,566.

Method and Machine for Converting Carbon Dioxide to a Solid. Thomas B. Slate, New York, N. Y., assignor, by mesne assignments, to International Patents Fiscal Corporation, New York, N. Y.—1,643,590.

Absorber. Julian A. Campbell, Long Beach, Calif.—1,643,696.

Process of Separating Oily Emulsions. George W. Coggeshall and Arthur Reilly, assignors to The Jefferson Construction and Oil Treating Company, Washington, D. C.—1,643,698.

Process of Treating Emulsions. George W. Coggeshall and Arthur Reilly, Washington, D. C., assignors to The Jefferson Construction and Oil Treating Company, Washington, D. C.—1,643,699.

Process of Manufacture of Carbon Black. Clyde A. Barbour, Jr., Monroe, La.—1,643,736.

Tunnel Kiln. James Kelleher, Chippawa, Ontario, Canada, assignor to Harper Electric Furnace Corporation.—1,643,775.

Device for Protecting Condensers. Arthur G. Bogardus, Chicago, Ill., assignor to The Griscom-Russell Company, New York, N. Y.—1,643,803.

Electrolyzer Electrode of the Filter-Press Type. Rodolphe Pechkranz, Geneva, Switzerland.—1,643,900.

NEWS of the Industry

Large Endowment Planned for Leather Research

FRASER M. MOFFAT, president of the Tanners Council of America has announced that the tanning industry will raise $1,000,000 to be used as an endowment for leather research.

The fund will insure the continuous and effective operation of the independent foundation incorporated last May for tanning research. This corporation, known officially as "The Foundation of the Research Laboratory of the Tanners' Council of the United States of America at the University of Cincinnati, Inc.," has taken over the leather-research work conducted for several years at the University of Cincinnati. The actual operation of the laboratory was not changed by the incorporation of the Foundation as an independent institution and will not be affected by the securing of the $1,000,000 endowment, which is expected to accrue from memorial bequests and other sources within the tanning industry. The significance of the incorporation and the endowment lies in the complete divorce of the research work of the industry from the fortunes and control of the Tanners' Council or any other trade organization.

Pacific Coast Gas Men Hold Annual Convention

THE THIRTY-FOURTH annual convention of the Pacific Coast Gas Association was held in Santa Cruz, Cal., Sept. 12 to 16. About 350 members were in attendance. The importance of this major industry to the Pacific Coast was stressed by the president of the Association, W. S. Yard. In 1926, the gas industry of the Pacific Coast marketed over one hundred billion cubic feet of natural oil, coal and water gas to a total of 1,450,000 customers or about one-fifth of the coast population. The equipment used is valued at $250,000,000 and there are a total of 15,000 miles of gas mains.

Progress in oil refining brought about by research stimulated by the demand for gasoline has resulted in a residuum of constantly lowering quality for the raw material used in production of oil gas. This and not the possibility of an oil shortage presages a change in gas making on the Pacific Coast from oil gas to water gas and coal gas. Production cost of water gas using coal is but slightly higher than that of oil gas.

Continued progress has been made in the liquid purification of gas, as reported by K. N. Cundall. The Pacific Gas and Electric Corporation has sold over 900 tons of sulphur obtained through this process, during the last eight months. Economies in operation have been effected and considerable work has been done in drying the sulphur paste, best results being obtained through the use of a tunnel drier.

A paper on the "Heat Transfer in Gases Containing Water Vapor" contained an immense amount of data not heretofore available. This paper was read in abstract by its author, Ted Rosebaugh, inasmuch as complete experimental data are not yet ready for publication. Preparation of a gas engineer's handbook is nearing completion under the direction of the Technical Section.

The new president is L. M. Klauber of the San Diego Gas and Electric Co. The next annual meeting will be held in Coronado, with regional meetings in San Francisco, Los Angeles and Vancouver.

Fellowship Plan Advocated for Wider Research

SUCCESS of the fellowship plan at the Bureau of Standards has led to the discussion of its extension to the Bureau of Foreign and Domestic Commerce. It is probable that the plan will be tried out first in the Chemical Division. Each fellowship would be financed by a certain branch of the industry. For instance, the fertilizer manufacturers may be interested in co-operating with the Chemical Division in working out some problem of their industry. By contributing the services of a specially selected man, who would have all of the facilities of the Department at his disposal, an opportunity would be offered to develop information of value.

Such fellowships, it is believed, could be used to great advantage at this time in connection with the dye, naval stores, the prepared medicines, the phosphate rock and toilet preparation industries. In addition to gathering the specific information which may be assigned the fellow, the plan has the important phase of starting a well-qualified young man in a specialty which will be of continuing value to these various chemical industries.

Chemical Exposition to be Held Biennially

THE ELEVENTH Exposition of Chemical Industries held in Grand Central Palace, New York, September 26 to October 1, marked a week of activity in chemical and chemical engineering circles fully as successful as in any previous year. There were approximately 75,000 admissions during the week with a registration of 15,600 individuals directly interested in the exhibits. Exhibitors occupied four floors of the building and numbered 367.

During the week announcement was made that, in conformity with exhibitors wishes, the exposition would continue on a biennially basis and it is now announced that the twelfth exposition will be held at Grand Central Palace, New York, during the week beginning May 6, 1929.

One of the features of the exposition was the Students' Course in Chemical Engineering conducted under the leadership of W. T. Read, head, Department of Chemistry, Texas Technological College, Lubbock, Texas. Interest in this course has increased successively during the past four years and was evidenced by the attendance this year of 162 students, the largest number in the history of the course. Plans have already been laid by Dr. Read for an expansion of the course at the next exposition, particularly for advanced students.

IN CONJUNCTION with the exposition, the fifth annual Chemical Industries banquet was held on Wednesday evening, September 28, in the grand ballroom of the Hotel Roosevelt. Nearly 500 members of the industry were present. John E. Teeple presided as toastmaster. Nicholas Longworth, speaker of the House of Representatives had been selected to deliver the principal address but was unable to be present. C. C. Concannon, chief of the Chemical Division of the Department of Commerce, spoke on industrial conditions in Europe as he found them on his recent trip abroad. E. M. Allen, president of the Mathieson Alkali Works discussed conditions confronting the chemical industry and took decided exception to existing laws which restrict domestic producers in their competition with foreign combinations. L. V. Redman, vice-president of the Bakelite corporation spoke on the value of research work. Rev. J. L. Davis also spoke.

Engineers Discuss Use and Abuse of Fuels

PRESENT FUEL waste and means for fuel conservation weigh increasingly on the national mind. This has resulted in a number of meetings and conferences among those actively concerned, the latest of which was the First National Fuels Meeting, held in St. Louis, Mo., Oct. 10 to 13, under the auspices of the Fuels Division, American Society of Mechanical Engineers.

This meeting was primarily concerned with the practical aspects of waste avoidance in fuel using. Nearly 700 engineers and industrialists studied and discussed papers dealing with present-day methods. Fuel resources, combustion methods, steam generation, fuel saving, carbonization and producer gas generation, refractories for severe conditions, the use of fuels in brick kilns, coal mining, coal preparation, coal purchasing, and smoke abatement were among the topics that came before the meeting.

IMPORTANT to chemical engineers was the paper by R. T. Haslam and H. C. Hottel of Massachusetts Institute of Technology on "Combustion and Heat Transfer." This paper discussed the heat transmission peculiar to process depending upon combustion, such as steam generation, and developed formulas applicable to the design of apparatus in which such heat transfer occurs.

In a paper on "Recent Developments in Low Temperature Coal Carbonization," H. D. Savage, vice-president, Combustion Engineering Corporation, told of the first large scale low temperature plant to be built in the United States. This plant, now being constructed at New Brunswick, New Jersey, employs the "KSG" process. It is designed to produce about 8,000,000 cubic feet of gas per day, which is to be distributed by the Public Service Corporation of New Jersey. Contracts are said to have been made for the disposal of all the tar that will be produced. The semi-coke will be sold as a domestic fuel. Colonel Savage also stated that five low temperature plants are at present contemplated for immediate erection in this country. This marks the start of the commercialization of the low-temperature process in America.

The wider extension of the use of gas as a fuel, both directly in gas engines and by combustion in furnaces, was forecast in a paper presented by W. B. Chapman, vice-president, Chapman Engineering Company. After tracing the development of producers, Mr. Chapman described the most recent design, which gives continuous, automatic production of blue gas or producer gas of constant quantity and quality. This improvement is said to overcome the difficulties formerly encountered in the extension of the use of these gases and thus greatly to extend their service range.

Smoke abatement was discussed in several papers and from various angles. It was apparent that this subject is becoming increasingly important in all cities. The fuel waste, money loss and health menace of a smoke polluted atmosphere merit serious consideration. While the enforcement end of any smoke abatement campaign must be left in the hands of government, the chemical engineer can play a major part in devising methods and equipment which will prevent the production and emission of smoke.

Chemical Executives Meeting Under Consideration

ONE OF THE matters to be decided at the forthcoming meeting of Secretary Hoover's chemical advisory committee will be whether or not another meeting of chemical executives will be held this year. If it is possible to have such a meeting plans will be made for the program to be followed.

There will be discussion of plans for strengthening the foreign reporting service on chemicals and of the proposal to assign chemical trade commissioners to Latin America, the Far East and the Near East.

Application of the fellowship idea to the chemical division is another subject to come before the committee. It has been suggested that a number of the chemical industries would profit by maintaining a fellowship in the division. In turn this plan would make it possible for the division to do some work alone various specialized lines.

Increased Import Duty Asked for Fluorspar

THE United States Tariff Commission has received a brief filed on behalf of the fluorspar producers of the Illinois-Kentucky field, applicants for an increase of 50 per cent in the present tariff duties on imported fluorspar. The brief stated that there was no substantial difference in quality between domestic and imported metallurgical spar and no adjustment required. The brief also pointed out that it had no objection to a reclassification of acid spar but urged if reclassifications are made they should be based on chemical analysis. The brief also said that conditions in the industry were precarious and the commission was asked to issue its report on this investigation at the earliest possible date.

Synthetic Rubber Interests German I. G.

A report to the effect that the German Interessen Gemeinschaft is about to embark upon a research program looking to the production of synthetic rubber has reached this country. The matter was regarded as of sufficient importance to justify the calling of a special meeting of the I.G. Board, it is said. There is a rumor to the effect that a very promising process has been developed in Germany and that the rights have been secured by the I.G.

Methods of Refining Shale Oil are Studied

FOLLOWING the closing of the experimental oil shale plant of the United States Bureau of Mines, near Rulison, Colo., studies of the best methods of refining shale oil are being made at a number of institutions. Two 6,000-gal. tank cars of shale oil produced at the plant have been shipped to the League Island Testing Plant of the Navy Department, where tests will be made to determine the suitability of raw shale oil as fuel for naval vessels. This represents the first tank-car lot shipment of shale oil made on the North American continent. Approximately 150 bbl. of the oil produced was sent to the Boulder, Colo., laboratory of the United States Bureau of Mines, where studies are being made in a $10,000 experimental refinery erected by the state of Colorado. A total of about 100 bbl. of shale oil has been shipped to a number of oil refineries and laboratories, where studies will be made to determine the best methods for refining this oil. The results of these investigations will be made known to the Bureau of Mines.

Magnesium Deposit Worked in California

THE American Magnesium Co., Los Angeles, Calif., is developing maximum production at its new refining plant at Wilmington, Los Angeles Harbor. The company has a large magnesium deposit at Magnesium, San Bernardino County, and output is now on a basis of 15 tons of raw material per day for use at the refining plant. Here the magnesium is being converted into three basic products, epsom salts, magnesium carbonate, light precipitates, and glauber salts.

Fellowship for Research in Tallow and Greases

The Emery Candle Co. of Cincinnati has established a fellowship at the Mellon Institute of Industrial Research, Pittsburgh, Pa. The fellowship will be under the direction of Dr. Robert N. Wenzel of California who will conduct research in tallows and greases, looking toward the betterment of distillation and saponification processes as adapted to the stearic acid and red oil industry.

Spanish Potash Mines Not A Market Factor

After a visit to the potash mines near Suria in the Province of Catalonia, in Spain, C. C. Concannon, the chief of the chemical division, of the Department of Commerce, is convinced that these deposits will not be a factor in the world trade unless some practical plan can be worked out for carrying the potash in solution by pipe line to Barcelona.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

WASHINGTON IS much concerned over the tariff question raised by France because of the underlying principle involved rather than the effect it would have on our commerce. It is recognized, however, that if the French precedent were followed by other nations that the world would soon be in the grip of trade wars and antagonisms that would engender international bitternesses and would lead inevitably to war. It is this larger aspect of the question which causes concern on the part of the administration.

In so far as chemicals and allied products are concerned in the controversy the United States is in a particularly independent position. Sulphur is our principal export and as it is on the free list it apparently will not be affected. Potash, the principal import, also is a free-list commodity.

France is a purchaser of American benzol, carbon black, paints, acids and a long list of chemical commodities, but the total does not average more than $5,000,000 annually.

On the other hand, the United States buys some $15,000,000 of chemical and allied products in France, practically all of which can be purchased elsewhere without great hardship. Some of the principal items with the values of 1926 imports are: perfumes, $2,000,000; perfume materials, $817,000; vanilla beans, $1,900,000; crude glycerin, $1,400,000; olive oil, $786,000; argols and wine lees, $1,000,000; cosmetics, powders and creams, $500,000; casine, $243,000; soaps, $266,000.

WHILE IT is believed that the President will be very reluctant to exercise the authority granted him in Section 317 of the Tariff Act, under which he may increase duties fifty per cent, or declare an embargo in cases of discrimination, little hardship would result to the United States from this action. Perfumes and cosmetics can be secured elsewhere, as is the case with vanilla beans, glycerin, and most of the other French products which we use. The opinion is expressed that the most difficult single French article to duplicate is the high-grade casein which is prepared in that country.

The French make strong point of the fact that there has been a large decrease in their exports to the United States. An analysis of the situation, however, indicates that little, if any, of the falling off is due to the tariff. Prohibition has reduced the visible imports, at least, of French wines and liquors. For economic reasons chromite now comes largely from Africa rather than from New Caledonia. The increased use of the electric furnace has reduced the amount of graphite bought in Madagascar. In 1921, eighty-five per cent of all imports of tinsel products came from France, but for the last three years French producers have not been able to meet the prices of their German competitors. There are other instances where changes in industrial practice have worked against French goods.

Since France has everything to lose and so little to gain from such a tariff policy, the impression in Washington is that the action taken was a move in the debt settlement controversy.

THE INCREASES which have been made by the Customs Division of the Treasury Department on certain articles of French importation were matters of ordinary administration procedure under the provisions of the tariff law of 1922 and do not represent any change whatever in American tariff policy, it was explained at the Treasury Department, following the issuance of the Customs order. The law, it was pointed out, provides that whenever there is any advance in rates by a foreign government on American products the rates applied here on the same imports from that country shall be similarly increased. That is what was done in connection with the change in the French schedule of rates on certain American products as a result of the Franco-German reciprocity treaty by which each of those countries gave to the other certain trade benefits.

The action taken in the matter, therefore, was mandatory, the Treasury Department having no discretion, but simply following the usual procedure in all such cases. The Department had not consulted with the State Department or any other department in regard to the matter before issuing the customs order, but after having been informed by the Department of Commerce, which regularly advises the Treasury of any changes in foreign tariff schedules, ordered the new increase in rates here to be applied.

As an illustration it was pointed out that Section 369 of the tariff act provides that the duty on automobiles, automobile bodies, etc., and part of the foregoing, not including tires, whether finished or unfinished, shall be 25% ad valorem and if any country imposes a duty on any article specified in this paragraph in excess of the duty provided for, there shall be imposed, either directly or indirectly, a duty equal to that imposed by such country. This and similar provisions of the tariff act in regard to other articles, it was pointed out, is mandatory and the only policy is that which has been fixed by Congress.

In explaining the manner in which such action is taken from time to time in regard to certain foreign imports the Treasury issued the following statement:

"Under the tariff Act of 1922, several commodities are conditionally free, the condition being that the country of exportation imposes no duty on similar commodities from the United States. An example is Paragraph 1543 with reference to cement. On the dutiable list likewise there are several paragraphs that make the amount of duty dependent upon the rate of duty assessed by the exporting country on similar goods from the United States.

"To keep the Collectors of Customs advised as to the rates of duties assessed on merchandise covered by these paragraphs, the Department of Commerce advises the Treasury Department of all changes in import duties by all foreign countries on commodities covered by the several paragraphs providing for conditional rates. This information in turn is published in the weekly Treasury decisions for the information of Customs officers and business interests concerned. The publication of these tariff changes represents no discretionary act on the part of the Department. Tariff changes of this character are not uncommon, and Treasury Decisions publishing these rates similar to the one in question are issued many times during the course of the year and attract little newspaper comment. The furnishing of this information to the Customs officers is a necessary and more or less routine matter. If the information were not published by the Department, the Collectors would be compelled to secure the information from other sources, and delays in the liquidation of duties would result."

At the State Department it was explained that this increase in tariff has no relation to Section 317 of the Tariff Act. Increases made under the form are specific, while Section 317 is a general provision allowing the President to impose additional duties on products of any foreign country in case of discrimination by that country against American imports, or if the discrimination is continued by the foreign country even to place an embargo on part or all of its imports.

The present action in increasing the French duties, it was explained, is not reciprocity and does not mean in any sense that the Tariff Act can be interpreted as affording opportunity for negotiating with foreign countries on a reciprocal basis.

The opinion was expressed at the State Department that the action which has been taken increasing duties on certain French products will not have any effect on the contemplated negotiations with France in an effort to adjust the present tariff differences and to conclude a treaty of commerce and amity between the two countries.

Having outgrown the available space assigned it on the fourth floor of the Commerce Department Building at Washington, the chemical division has been moved to the second floor of the building where it has been given fifty per cent more office space.

Improvement Shown in British Trade in Chemicals

Development of Dead Sea Resources May Give Large Potash and Bromine Supplies

From our London Correspondent

DEMAND FOR heavy chemicals is improving and there is every prospect of prices generally improving slightly during the next few months. A feature of particular interest was the recent announcement that imported ethylene glycol and glycol ethers were definitely exempted from duty from August 19 to March 6, 1928. This announcement had been awaited with interest, particularly as a leading concern is said to be building a large plant in this country for the manufacture of these solvents. Generally healthy conditions in all industries are spoken of as being more than a possibility and a revival of technical activities may also be predicted. Reference has previously been made to the negotiations which have been proceeding in regard to the chemical resources of the Dead Sea in Palestine and it is common knowledge that a Mr. Nowomesky has, with others, been granted a concession which is to be the basis of the future working arrangements for a leading British concern. The name of Imperial Chemical Industries is an obvious and a likely guess in this connection, but naturally details and all information are being refused officially for the present and some time must elapse before any decision or announcement is made or the final details settled. Potash is likely to be the principal aim, with bromine a poor second, and of course, a part of the common salt recovered can be utilized locally. The rest of the salt and other unsalable products would probably have to be returned to the Dead Sea and, naturally, suitable stipulations will be made for favorable prices and treatment for local consumers of fertilizers and other products. The next step should be the despatch of technical experts, followed by the expenditure of some hundreds of thousands of dollars upon preliminary development work, and it is quite possible that part of this work will be carried out before a final announcement is issued; there is also some foundation for thinking that American interests, which have been by no means inactive, will to some extent be safeguarded and encouraged. The statements made hitherto as regards costs appear to have been somewhat optimistic, but there seems no reason to doubt that in the right hands and with adequate financial and Government support, the Dead Sea may become a material factor at least in the potash market and in the future development of the mandated territories.

The negotiations between the German I. G., the Standard Oil interests and Imperial Chemical Industries continue to be the subject of gossip and rumor and the more frequent meetings of the leading industrialists of Great Britain and Germany on economic questions give support to the idea that something tangible may be evolved.

From South Africa comes a report relating to the discovery of extensive deposits of a uranium thorium mineral said to contain 73 per cent of uranium oxide and 12 per cent of thorium oxide. The absence of rare earths may render this occurrence of importance, seeing that the best monazite sands with about the same thoria content have the disadvantage as regards refining processes of the presence of cerium, didymium etc. The difficulty will be to know what to do with the uranium oxide, the consumption of which in the pottery industry appears to be limited, even if available at a low price.

THE NEW subsidiary company, Nitram Limited, organized by Brunner, Mond & Co. and Imperial Chemical Industries as a sales organization for fertilizer products and for agricultural propaganda work generally, appears to have a successful future before it and it is interesting to note that Dr. E. H. Tripp, a former Editor of *"Chemistry & Industry,"* is associated with this enterprise. Naturally, it was a little depressing to have to announce recently a very substantial reduction in the price of sulphate of ammonia to an average of about $50 per ton during the next few months. There is some prospect that this policy, which is no doubt to some extent due to the progressive increase in the manufacture of sulphate made from synthetic ammonia, will lead to the more general use of this class of fertilizer, which is peculiarly suitable for the British soil, crops and climate. On the other hand, compound fertilizers are frequently in demand and the use of very finely divided calcium carbonate has found favor as a substitute for lime in neutralizing the acidity of soils. With this in mind and also on account of the large quantities of waste carbonate of lime sludge available for disposal at the Billingham synthetic ammonia factory, Nitram Limited have introduced a new fertilizer "Nitrochalk." This is merely a mixture of ammonium nitrate and dried Billingham carbonate of lime sludge with a resultant content of about 10 per cent of nitrogen. The lime sludge itself contains about ¾ per cent of ammonium sulphate, and sales of "Nitrochalk" will naturally depend not only upon the price per unit of nitrogen content, but upon its drilling and keeping properties.

The Hycolite Liquid Wallpaper Manufacturing Co. has just been registered, with a capital of $150,000. This indicates that the product introduced about a year ago is finding increasing favor. Hycolite is, as the name of the company implies, an aqueous pulp suspension with suitable fillers, driers, binders and coloring matter, which, when painted on walls, forms a thin coherent sheet having the appearance of plain wallpaper, with the advantage that it is warmer to the touch than a distemper or other water paint. Its application, though cheap, is hardly likely to be completely satisfactory unless the wall surface is quite smooth and it is understood that some interesting technical problems require solution before results warranting the present extension of activities could be obtained. The cement industry still continues to flourish, but there is every indication of a price war in the near future. A rival grouping to the Associated Portland Cement Manufacturers group appears to be in the process of formation, with substantial American and English backing. The new shares have been eagerly taken up in view of the large potential profits at present prices, but the "spread" available to the existing organizations is in many cases so great that when the present "liveliness" develops into actual hostilities, the price reduction may be almost spectacular. "Ferrocrete," the rapid-hardening cement, continues to find increasing favor, particularly for urgent road work and for the construction of rush jobs like greyhound racing tracks, of which there has recently been an epidemic.

Flexible Tariff Case Denied Early Hearing

FINAL DECISION as to the constitutionality of the flexible provisions of the 1922 Tariff act probably will not be made for several months. The United States Supreme Court Oct. 10 refused to grant a motion to advance for early hearing the appeal from a decision of the Court of Customs Appeals which had upheld the constitutionality of the law in a case assailing the provisions brought by W. J. Hampton, Jr. & Co., importers of barium dioxide. The case will be reached and decided in the regular order, probably next Spring.

The Hampton company filed a protest under the Tariff act against imposition of increased duties of barium dioxide after the President had proclaimed higher duties as a result of an investigation into costs of production. The Board of General Appraisers and subsequently the Court of Customs Appeals upheld the constitutionality of the flexible tariff, both by divided votes. The company appealed to the Supreme Court, and both sides asked an early hearing in order to bring the test to an early conclusion.

In its correspondence regarding the tariff controversy between the two countries, the French government has suggested that the flexible tariff be employed by the United States as a method of reducing duties on certain merchandise France exports to this country.

Allocation of Alcohol Production Under Flexible Program

WITH THE AID of a carefully chosen industrial advisory council James M. Doran, the Commissioner of Prohibition, feels certain that no hardships will result from his program of allocating alcohol production on a basis of past performance and production.

Dr. Doran believes this method of allocation is better than one based on capacity. He points out that capacity is at least two and one-half times greater than the present rate of production. Moreover, he believes there is every reason for discouraging greater capacity either in the way of enlarging existing plants or in constructing new ones.

Dr. Doran called the attention to the waste and instability which has come to agriculture, to coal mining, and to other industries because of overproduction. Similar waste and similar instability results to the industrial alcohol industry when there is overproduction, but in addition overproduction of that commodity is a prolific breeder of lawlessness and makes for a social condition which is likely to react against the industry.

THERE is nothing inflexible about allocations, Dr. Doran declares. They will be modified as current requirements demand. A quantity will be prescribed and varied at each plant which will allow adjustments to meet any increase or decrease in demand. When it becomes evident, he states, to the advisory council that a shortage exists it will be a simple matter to bring about an adjustment. As consumers of alcohol are well represented on the council he believes that there is every safeguard against too stringent curtailment. By having a well-balanced council with intimate first hand knowledge of the industrial situation Dr. Doran is certain that action can be taken on reliable facts rather than on guesses which might not work out to the best advantage.

When Mr. Doran was chief chemist of the Prohibition Unit he had frequent occasion to call attention to the fact that alcohol is used for other than beverage purposes and that it is one of the major materials among those that are essential in industry. Now that he has become the chief enforcement officer of the prohibition statutes he wants it clearly understood that his opinion of the importance of the legitimate use of alcohol has changed in no degree whatsoever.

When Dr. Doran was asked what he thinks of a plan whereby the industry would select some outstanding man in its own ranks to function along lines followed so successfully by Will Hays in the motion picture industry, or L. C. Storrs in guiding the electric railway companies, he expressed the opinion that in the hands of a well chosen man such an effort could be productive of great benefits. He emphasized the fact, however, that there is nothing so acute in the industrial alchol situation as to call for a dictatorship, but he believes great good could be accomplished by centralizing in one man the responsibilities for the industry's public relations and for the conduct of its business along proper lines.

Alcohol Manufacturers Meet in Baltimore

MEMBERS OF the Industrial Alcohol Manufacturers Association met in Baltimore, Sept. 16, where they were guests of the U. S. Industrial Alcohol Co. During the day both the alcohol and chemical plants of the company were inspected, lunch being served in the new cafeteria of the U. S. Industrial Chemical Co. In the evening the visitors were entertained at dinner at the Belvedere Hotel where they were addressed by Dr. James M. Doran, Prohibition Commissioner.

Dr. Doran spoke briefly but forcibly of plans he had in mind for the regulation and control of the manufacture of industrial alcohol. His remarks were favorably received by members of the Association who pledged their support of the Commissioner in his new plans.

Dr. Doran spoke, in part, as follows: "At this time we have built up, through the regulations and the training of our officers, an effective system of distribution control that might be compared to canals and cross canals of a large irrigation project. We have not yet, however, reached the point where we have attempted to control the supply of water that might periodically enter the system and give the maximum results. On the contrary, our failure to control the source and volume has resulted in what inevitably would happen in an irrigation system if the same lax conditions prevailed. This was pointed out to me by one of our chief law officers, and the soundness of bringing about a quantitative production control is not open to question either from a legal, commercial or law enforcement standpoint. I have made a close study of alcohol production for many years and I feel safe in saying that a control of production within known and reasonable commercial needs will benefit law enforcement immeasurably. Likewise, there is no diversion of industrial alcohol that does not leave a commercial scar. I would be negligent in my duty as an official and friend of industrial alcohol if the present situation was not squarely met. It will be my policy to institute a quantitative control of alcohol production in the coming calendar permit year that will be ample for all industrial needs and consistent with the Government's interest along law enforcement lines."

Members of Industrial Alcohol Manufacturers Association at U. S. Industrial Alcohol Co.'s plant

Upper row—Philip Devlin, Walter Trautman, A. P. Jell, A. W. Huguley, A. K. Hamilton, J. J. Carroll, Glenn Haskell, R. H. Buckie, B. R. Tunison, Joseph Wrench, Sid Klein, Richard Grimm, Z. Phelps, P. W. Fleischmann, A. A. Backhaus.

Lower row—W. H. Hoodless, S. S. Neuman, Philip Publicker, R. R. Brown, George Dieterle, Frank Rogers, H. I. Peffer, Victor O'Shaughnessy.

News in Brief

COMMERCIAL ATTACHE L. W. Meekins, Ottawa, reports that the Canadian Board of Customs has ruled that aniline or coal tar dyes, in liquid form, soluble in water, may enter under tariff item 203. This item provides for the free admission of aniline and coal tar dyes, soluble in water, in bulk or packages of not less than one pound in weight, and the present decision extends free admission to such dyes in liquid form. Certain liquid dyes have heretofore been subject to duty at 40 per cent ad valorem.

THE GOAL of many years' endeavor was reached by the Engineers' Club of San Francisco when its new home was dedicated on Sept. 30. This club, which is now fifteen years old, includes in its membership engineers engaged in all branches of the profession, the total membership being about 750. The new quarters occupy the two top floors, 14th and 15th, of a new building at Pine and Sansome Sts. The space was arranged in the design of the building expressly to suit the needs of the club and great care was taken in the selection of furnishings and equipment. The completed plant is particularly well adapted to serve as the focal point for engineering society activities in the San Francisco Bay region.

HUGH R. WILSON, the American Minister to Switzerland, accompanied by five technical specialists, will represent the United States at the Conference on Import and Export Prohibition and Restrictions which opens in Geneva on Oct. 17.

E. I. DU PONT de Nemours & Co. will build a rayon plant near Richmond, Va. Work will begin soon and it is planned to have the plant in operation within a year. The site for the plant comprises 400 acres on the Atlantic Coast Line Railway about three miles from Richmond city limits.

ACCORDING TO W. T. Daugherty, trade commissioner at Berlin, it is reported in Germany that an American corporation has contracted with I. G. Farbenindustrie A. G., the Metallbank & Metallurgische Gesellschaft, Frankfort-on-the-Main, and the Aussiger Verein, Czechoslovakia, to exploit German patents on activated carbon in the United States. At the same time, the French Societe de Charbons Actives Urbaine acquired rights on German patents for exploitation in Europe, outside of Germany.

THE AMERICAN Oil Chemists Society has decided to hold a Fall meeting each year. The first Fall meeting will be held at the Chemists Club, New York City, on Oct. 28.

THE SCHOOL of Petroleum Engineering, University of Oklahoma, Norman, Okla., has been presented with a complete oil refining unit, costing about $30,000. The new plant consists of a pipe still for heating oil, with a fractionating tower, about 80 ft. high, for separating the crude oil into its various products. Gasolines, naphthas and illuminating oils will be removed near the top of the tower, lubricating oils at a point lower, and residual oils in the form of asphalts, road oils and cylinder stocks at the bottom of the unit.

UTILITY OF the candelilla plant, which grows wild in the upper border region of Texas, is being extended through chemical research. For many years, the weed has been used for the extraction of wax and late developments indicate that it may be a source of crude rubber. It has now been determined, also, that the ashes from the waste, or bagasse, which comes from the candelilla after the wax has been extracted contains a large percentage of potash, the weeds producing from three to four tons per acre. The guayule shrub, which thrives in the same territory, is being used for the production of crude rubber, and the Continental Rubber Co. is operating a mill for this manufacture in the vicinity of Marathon, Tex.

Larger Alcohol Production in Germany

A RECENT meeting of the council of the German Alcohol Monopoly considered the price and production policy for the coming "alcohol year" beginning October 1, 1927. Production that has been artificially held down to a 65 per cent quota during last year will probably be raised to 100 per cent, as the monopoly's turnover during the fiscal year has been extremely satisfactory.

Trade Commissioner Daugherty reported that sales of potable alcohol in Germany in the last fiscal year are estimated at about 675,000 hectoliters, against 562,000 hectoliters in the previous year. Sales of alcohol for production of medicinals and cosmetics will reach 50,000 hectoliters, against 41,000 hectoliters a year ago. Low-priced alcohol, including that sold as motor spirits were sold in the amount of 1,250,000 hectoliters, against 1,030,000 hectoliters in the 1925-26 fiscal year. Monopoly stocks on hand of around 1,000,000 hectoliters at the end of 1925-26 have dropped to between 360,000 and 400,000 hectoliters.

Reduction Predicted in Duty on Phenol

THE TARIFF Commission has sent its report on phenol to the President. All comment on the report was withheld, but a reduction in the duty is expected. The duty on phenol is 40 per cent ad valorem, based on the American selling price, plus 7c. per lb. The application for a reduction came from James F. Ballard, a manufacturer of proprietary medicines, but the request has wide support among consumers, including manufacturers of antiseptics, disinfectants, pharmaceuticals, explosives and dyes and among the consumers of synthetic phenol resins and plastics, such as the makers of radio sets and automotive parts.

France Increases Demands for Nitrogen

From our Paris correspondent

CONSUMPTION of nitrogenous fertilizers has increased materially in France as is shown by official figures recently issued and covering the French fertilizer trade for 1926. During that year consumption of fertilizers in terms of nitrogen was equivalent to 110,570 tons as compared with 91,720 tons in 1925. The 1926 consumption represents the following materials in the amounts specified:

	Tons
Nitrate of soda	200,000
Sulphate of ammonia	310,000
Nitrate of calcium	27,000
Cyanamid	60,000
Oother nitrogen fertilizers	15,000
Total	612,000

During the same year, imports of nitrogen-bearing materials into France were as follows:

	Tons
Nitrate of soda	166,000
Sulphate of ammonia	150,000
Nitrate of calcium	39,000
Cyanamid	5,000
Total	360,000

These figures show that the French output of nitrogen is not sufficient to supply the needs of the country. Production of sulphate of ammonia has been gaining but the government plant at Toulouse with an annual capacity of 30,000 tons of nitrogen when fully equipped has been held inoperative because of lack of funds.

ONE of the outstanding features revealed by the statistics on fertilizer imports is the decline in shipments of phosphates from the United States. Morocco has made rapid gains in foreign markets and in 1926 shipped out 885,720 tons as against 721,228 tons in 1925 and 430,450 tons in 1914. Tunis exported phosphates to the extent of 2,815,000 tons in 1926 and 2,252,000 tons in 1925.

The increased output of phosphates has created keen competition and brought lower prices. As a result of this Algerian and Tunisian producers are planning the formation of a propaganda fund to exploit consumption of phosphates of North African origin. This fund will be obtained by an export tax of one franc on every ton exported from these countries with producers also paying a tax of one franc per ton on every ton exported. Possibly Morocco will join in this movement.

British Industries Fair To Open in February

The Thirteenth British Industries Fair, which will be opened simultaneously in Birmingham and London on February 20, 1928, and which will be closed on March 2, promises to surpass all its predecessors, according to a report from Consul John A. Gamon, London. Already twelve hundred firms have applied for exhibition space.

MEN *you should know about*

CHARLES W. CUNO has resigned his position at Washington University, St. Louis, and is to serve at Gottingen, Germany, for the coming year as guest professor, lecturing on the subject "American Practice in Chemical and Metallurgical Industries."

J. D. RUE, who has been chief of the paper and pulp section of the Forest Products Laboratory, at Madison, Wis., has resigned to direct the research work of the Champion Fiber Co., Canton, N.C.

H. R. BEARD has resigned his position as chief technologist of the Bureau of Fisheries to begin research work with the New England Fish Co., with headquarters at Vancouver, British Columbia.

FRANK PORTER has joined the research division of the Atmospheric Nitrogen Corp., at Syracuse, N. Y. He was formerly on the research staff of the U. S. Bureau of Mines, and more recently with the Marland Oil Co.

FRANK C. WHITMORE, head of the chemistry department at Northwestern University, is on sabbatical leave to serve in Washington as chairman of the Division of Chemistry and Chemical Technology of the National Research Council.

A. T. KASLEY, formerly head of the research department at the South Philadelphia works of the Westinghouse Electric & Manufacturing Co. has been appointed consulting engineer, Engineering Department, at that plant.

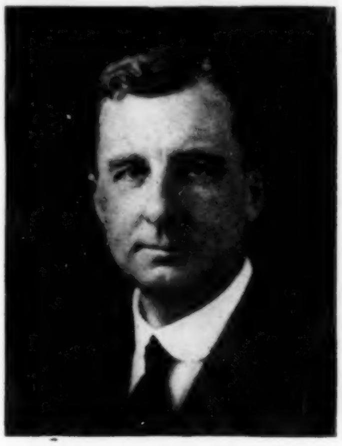
KENNETH M. HENRY, chief chemist of the Illinois-Pacific Glass Co. in San Francisco, Calif., and inventor of the electric lehr, has been elected to the directorate of the company. He is to represent the directors in the new Los Angeles plant.

CLIFFORD B. BELLIS, laboratory service engineer in New York City for the Bristol Company resigned October 1 to accept a position in sales and engineering work for the Foxboro Company, Inc., Foxboro, Mass.

THEODORE R. OLIVE, who was appointed assistant editor of *Chem. & Met.* on September 1, was formerly a member of the experimental engineering staff of the duPont Rayon Company at Buffalo, N. Y.

FREDERICK W. SPERR, JR., director of research for the Koppers Co., Pittsburgh, Pa., was awarded the 1926 Beal medal of the American Gas Association for a valuable contribution to the technical advancement of the gas industry in the form of an address delivered at the association convention last October. Mr. Sperr is the only man in the gas industry to be awarded the medal twice, having received it in 1921.

ARTHUR W. ALLEN, formerly assistant editor of *Chemical & Metallurgical Engineering* on the Pacific Coast has been appointed editor of *Engineering and Mining Journal,* another McGraw-Hill publication. In addition to worldwide experience in metallurgy, mining and chemical engineering, Mr. Allen also has had an impressive editorial career as a former member of the staff which he now heads and of *Mining and Scientific Press* and *Chemical & Metallurgical Engineering.*



ARTHUR W. ALLEN

CHAPLIN TYLER has resigned from the editorial staff of *Chem. & Met.* to become associated with the chemical department of Lazote, Inc., Wilmington, Del. Commercial research and technical sales development will comprise his duties.

PAUL D. V. MANNING, assistant editor of *Chem. & Met.* covering the Pacific Coast, at a recent commencement of Columbia University, was formally awarded the degree of Doctor of Philosophy in chemical engineering for work done at that institution before going to the Pacific Coast.

HENRY G. KNIGHT, dean of the college of agriculture and director of the experiment station of the University of West Virginia, has been appointed chief of the new Bureau of Chemistry and Soils of the United States Department of Agriculture.

ROBERT J. PIERSOL, formerly research engineer for the Westinghouse Electric and Manufacturing Company is now a consulting engineer at 3617 Dawson Street, Pittsburgh, Pa., specializing on the installation and operation of chromium plating.

E. E. DEARTH has been appointed chief chemist for the Fiske Rubber Co., at its Chicopee Falls, Mass., plant, succeeding Clifford W. Sanderson, resigned.

R. T. STULL, a ceramic engineer, resigned from the Georgia White Face Brick Co., Macon, Ga., to go with the Bureau of Standards, Washington, D. C.

HARRY HOUGH, heretofore vice-president of B. F. Goodrich Co., Akron, has been elected president of the company to succeed Bertram G. Work, who died recently in Switzerland. Mr. Work was also chairman of the board of directors and D. M. Goodrich has been elected to that office.

FREDERICK H. RHEAD, formerly director of research for the American Encaustic Tiling Co., Zanesville, Ohio, is now with the research division and director of the art division of the Homer Laughlin China Co., Newell, W. Va.

J. A. GUYER, formerly with the Mathieson Alkali Works, Inc., New York, is now in the research department of the Phillips Petroleum Co., Bartlesville, Okla.

HAROLD R. HARNER has resigned from the research department of the Eagle-Picher Lead Co., Chicago, Ill., to become assistant to J. H. Calbeck in the latter's consulting chemical laboratories at Joplin, Mo.

ALEXANDER R. ENTRICAN, engineer in forest products, New Zealand Forest Service, Wellington, N. Z., is making a tour of the United States for the purpose of studying wood-utilization problems with particular references to pulp and paper.

ROBERT A. MILLIKAN of the California Institute of Technology, Pasadena, Cal., has received the honorary degree of Doctor of Science from Leeds University, Leeds, England. Dr. Millikan has been director of the Norman Bridge Laboratory of physics at the Pasadena institution since 1921.

CHARLES H. LINDSLY is now with the United States Rubber Co. as chemist in the development department at the Morgan & Wright Works, Detroit, Mich.

H. R. MOORE is now a member of the staff of the cryogenic laboratory of the Bureau of Standards, Washington, D. C. He was formerly connected with the technical department of the Eastman Kodak Co., Rochester, N. Y.

W. R. BARRETT, formerly chief chemist for the Brush Duco Laboratory, Philadelphia, Pa., is now with the paint and varnish division of E. I. du Pont de Nemours and Co. at Chicago, Ill.

O. F. BRYANT has been appointed manager of the mill of the Nashwaak Pulp and Paper Co., St. John, N. B.

RAY T. WATKINS who recently resigned from the Canadian Research Council, Ottawa, is now with the ceramic division of the United States Tariff Commission, Washington, D. C.

WALTER SENNHAUSER, mechanical engineer for Sulzer Brothers, Ltd., of Switzerland, is now chief engineer of the Dry Quenching Equipment Corp., a new subsidiary of the International Combustion Engineering Corp. which was organized to exploit the recently acquired American rights to patents covering the Sulzer system for dry quenching coke.

CHARLES C. PHELPS, combustion engineer, has removed his office from Paterson, N. J. to Room 528, 30 Church Street, New York.

W. H. FINKELDEY has resigned his position as assistant chief of research of the New Jersey Zinc Co., with which he has been connected for the past ten years, to become associated with the firm of Singmaster & Breyer, consulting chemical and metallurgical engineers, 420 Lexington Ave., New York. Mr. Finkeldey has specialized in the processes and problems of the galvanizing industry, the production of zinc base alloys, and the manufacture and uses of rolled zinc.

J. V. N. DORR, who has been abroad for the last three months, arrived in New York October 1, aboard the S.S. "Roma." During his stay he conferred with his business associates in London, Paris and Berlin, and with members of his foreign staff visited many of the industrial centers of Europe.

JAMES R. LORAH, recently research fellow at the University of Washington, Seattle, Wash., has been appointed assistant professor of chemical engineering at the University of Missouri, Columbia, Mo.

CHARLES E. MULLIN of Philadelphia has accepted an appointment as head of the department of textile chemistry and dyeing at Clemson College, Clemson College, S. C. He will continue his consulting work along textile and allied lines from the new location.

EDWARD R. WEIDLEIN, director, Mellon Institute, and president of the American Institute of Chemical Engineers, has been elected an honorary member of the Chemical, Metallurgical and Mining Society of South Africa.

ERIC H. EWERTZ, past president of the American Welding Society and formerly general manager of the Bethlehem Shipbuilding Corp., has opened an office at 50 Church Street, New York, as a consulting engineer on problems relating to welding, mechanical and economic engineering.

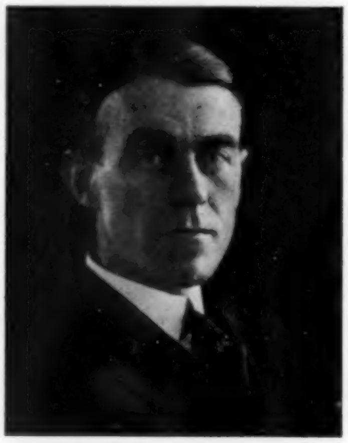
H. L. PAYNE, of Baverstock & Payne, who was severely burned in an explosion in the laboratory on September 3 is now out of danger and his eyesight is assured by the attending surgeon.

OBITUARY

FRANK C. WIGHT

Frank C. Wight, editor of *Engineering News-Record* and a distinguished figure in engineering journalism, died at his home in Summit, N. J., on September 16. He was but 45 years of age and in the midst of an active career that had included 21 years of editorial service on the McGraw-Hill publication and its predecessor, *Engineering News*.

After graduating as a civil engineer from Cornell University in 1904, Mr. Wight entered the office of the engineer of bridges of the District of Columbia, and for three years specialized in the design and construction of reinforced concrete structures. It was this interest that persuaded him to enter the field of technical journalism and through his continued study and writings he became a recognized authority on reinforced concrete construction. He was an active member and committeeman of the American Concrete Institute and in 1923 was chairman of the notable concrete and cement symposium held by the American Society for Testing Materials.



FRANK C. WIGHT

Frank Wight was an engineer of broad interest and understanding. He contributed brilliantly to the many fields of civil engineering. As an editor he was distinguished by his forceful, fearless writing—backed always by deep knowledge, critical judgment and far-seeing vision. His influence on technical journalism extended beyond his own paper and the related publications of the McGraw-Hill group. He was a former chairman of the New York Editorial Conference and at the time of his death was president of the National Conference of Business Paper Editors.

SVANTE A. ARRHENIUS of the University of Stockholm, Sweden, who was awarded the Nobel prize in 1903, the Frank medal in 1920 and the John Ericsson medal in 1926, died Oct. 2 at the age of 68. He was the originator of the theory of electrolytic dissociation first announced in 1884 and amplified in 1887.

WARREN FETTER HUBLEY, president of the American Transformer Co. died September 19 of a heart attack following acute indigestion. He was treasurer of the Institute of Radio Engineers, a director of the National State Bank of Newark and a charter member of the Newark Athletic Club. Mr. Hubley was born in Lancaster, Pa. in 1880. His wife, a daughter, Barbara, and a son, Richard, survive.

NORRIS B. GREGG, who since 1917 has been vice-president of the National Lead Co., New York, died at the local Polyclinic Hospital recently, following an operation, aged 70 years. Mr. Gregg was born at St. Louis, Mo.

CALENDAR

AMERICAN CERAMIC SOCIETY, tour through France, Germany, Czechoslovakia and England, May 19-July 16, 1928.

AMERICAN CONSTRUCTION COUNCIL, 6th annual convention, St. Louis, Mo., Dec. 1-3.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, St. Louis, Mo., Dec. 5-8.

AMERICAN OIL CHEMISTS' SOCIETY, fall meeting, Chemists' Club, New York, Oct. 28.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Iron & Steel Division, national meeting, Youngstown, Ohio, Nov. 10.

IRON & STEEL INSTITUTE (American), Hotel Commodore, N. Y., Oct. 28.

NATIONAL EXPOSITION OF POWER & MECHANICAL ENGINEERING, New York, Dec. 5-10.

NATIONAL SYMPOSIUM OF GENERAL ORGANIC CHEMISTRY (second) Ohio State University, Columbus, Ohio, Dec. 29-31.

INDUSTRIAL NOTES

THE CARBORUNDUM CO. of Niagara Falls, N. Y., has purchased the controlling interest in the American Resistor Corp. of Milwaukee, Philadelphia and New York. The principal products of the American Resistor Corp. are non-metallic electrical heating elements and resistors, which are marketed under the trade name of Globar. The new company will be known as Globar Corp. and has been incorporated under the laws of the State of New York. In reorganization Joseph A. Steinmetz, president, W. E. Duersten, vice-president and Walter W. Perkins, vice-president and treasurer, have been succeeded by Frank J. Tone, president, George R. Rayner, vice-president, F. H. Manley, treasurer, and Arthur Batts, secretary. These officers are also directors of the Globar Corp., together with Messrs. Steinmetz, Perkins and Sharpe of the old group. The new officers hold similar offices in the Carborundum Co.

ASSOCIATED BUSINESS PAPERS, INC., 52 Vanderbilt Ave., New York, has published a pamphlet showing the volume of business paper advertising placed by advertising agencies in member publications of the A.B.P. in 1926. The summary shows that 1,209 agencies placed such advertising in 1926 as compared with 1,079 in 1925, a gain of 12%. The number of pages placed in 1926 was 102,670 as compared with 82,716 in 1925, a gain of 23%. The booklet lists and ranks 753 agencies that placed 12 or more pages in A.B.P. publications in 1926. It also contains a statement of A.B.P. policies and purpose, standards of practice and names of member publications.

THE NATIONAL CHROMIUM CORP. has opened offices and begun the operation of the first unit of its chromium plating plant at 200 Varick St., New York City.

MARKET CONDITIONS *and* PRICE TRENDS

Larger Output of Coal-Tar Dyes in 1926

Increased demand for fast dyes greatly stimulated research and resulted last year in commercial production of many dyes which, previously, had not been made in this country.

DOMESTIC PRODUCTION of coal-tar dyes continued on an expanding scale throughout 1926, the total output reaching 87,978,624 lb. as compared with 86,345,438 lb. for 1925. The U. S. Tariff Commission reports that sales of domestic dyes in 1926 amounted to 86,255,836 lb. valued at $36,312,648 compared with 79,303,451 lb. valued at $34,468,332 in 1925. The weighted average price of all domestic dyes sold in 1926 was 10 per cent less than the weighted average of those sold in 1925. In fact there has been a steady decline in the average sales price since 1917 when the figure stood at $1.26 per lb. whereas the 1926 average was 42c. per lb.

Assuming consumption to equal total sales plus imports minus exports, 93 per cent of the total quantity of dyes consumed in this country last year was supplied by the domestic industry.

EXCLUSIVE of 8 firms producing stains and indicators, 53 firms were engaged in production of dyes in 1926. This is a decline of 16 producers since 1925 and of 37 producers since 1919. The United States has more dye manufacturers than the rest of the world combined. The capacity of domestic plants, estimated at about one-fifth the world's total capacity, is far in excess of the quantity that can be marketed. Increased competition will doubtless continue to eliminate plants.

An outstanding feature of the domestic dye industry is the increase in production of vat dyes other than indigo. The output of 4,030,421 lb. in 1926 is a gain of 54 per cent over 1925, which in turn was 43 per cent larger than in 1924. The output of indigo dyes was 25,701,530 lb. in 1926 as against 29,121,817 lb. in 1925. Sulphur dyes also fell away slightly as compared with the 1925 production and lake and spirit soluble dyes also failed to reach the figures attained in 1925 but other classes surpassed the 1925 totals with direct dyes showing the largest percentage of gain.

IMPORTS of coal-tar dyes in 1926 were 4,673,196 lb. valued at 4,103,301 as compared with 5,209,601 lb. valued at $4,637,240 in 1925. Germany supplied 50 per cent of total imports; Switzerland 33 per cent; England and France 4 per cent each; and Italy 2 per cent. Classified by method of application, 40 per cent of imports were vat dyes, 17 per cent direct dyes, 16 per cent acid dyes, 10 per cent mordant dyes, and the remainder, basic, sulphur, and spirit soluble dyes.

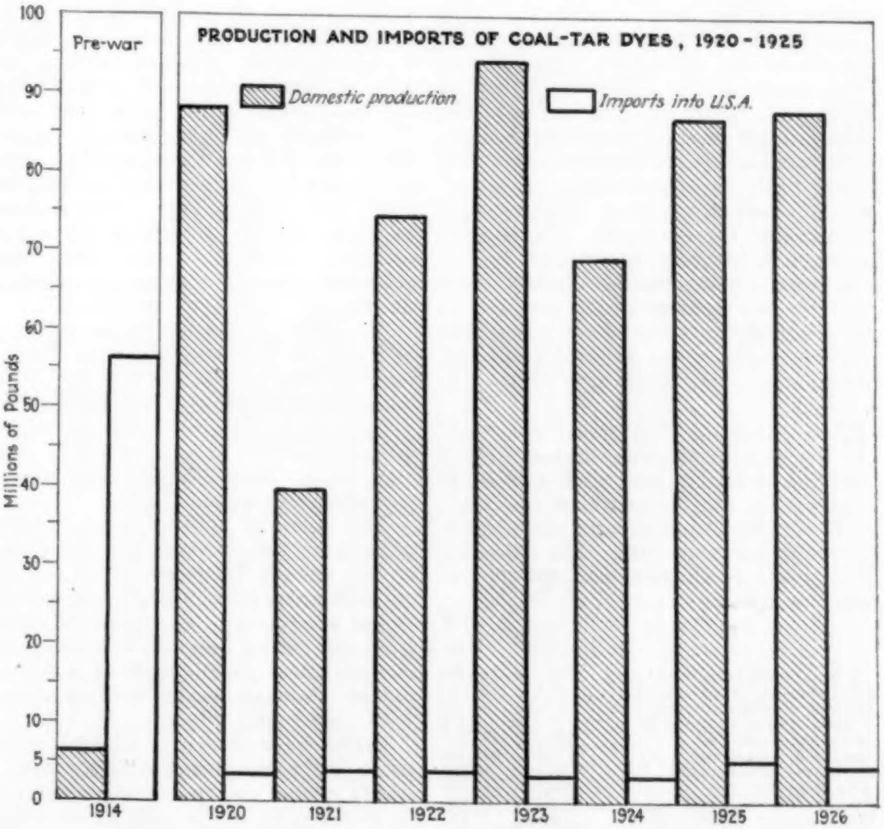
The poundage for imports is in excess of the actual quantities imported because nearly all the vat dyes and rhodamines were reduced to a single strength basis for sake of comparison.

Exports of dyes in 1926 were 25,811,941 lb. valued at $5,950,159. This was a slight increase in quantity over 1925 but a decline of 11 per cent in value. The principal foreign markets were China, Japan, British India, and Canada. The low priced bulk dyes, such as indigo and sulphur black are the principal colors exported. The following table offers comparisons for domestic production and foreign trade in dyes:

Production and Foreign Trade in Dyes

	Domestic Production Lb.	Imports Lb.	Exports Lb.
1926	87,978,624	4,673,196	25,811,941
1925	86,345,438	5,209,601	25,779,889
1924	68,679,000	3,022,539	15,713,091
1923	93,667,524	3,098,193	17,924,200
1922	64,632,187	3,982,631	8,344,187
1921	39,008,690	4,252,911	....
1920	88,263,776	3,402,582	....
1914	6,619,729	45,950,895	....

Of the 172 firms engaged in the manufacture of dyes and other coal-tar products in 1926, 44 had separately organized research laboratories. The total cost of the research work carried on, together with that done in laboratories not separately organized for research was $2,011,830. This figure is a decrease of $426,405 from that reported for 1925 but doubtless this is an understatement of the real cost of experimental work since the figures do not include in all cases, the cost of research forming a part of manufacturing operations.



MARKET CONDITIONS *and* PRICE TRENDS

Consumption of Chemicals Increased Last Month

CONDITIONS WHICH had a tendency to slow up production and distribution of chemicals during July and August began to assume a more favorable aspect in the early part of September and have shown gradual improvement from that time. General industry is still showing a spotted condition, with reports of activities in some lines tempered by apparent slowness in other directions. The steel industry, which is regarded as a barometer of business in general, has failed to show the recoveries expected and some reports credit smaller loadings of forest products and reduced steel output as indexes of falling off in building operations during the latter part of the year.

To a certain degree the industries which are large consumers of chemicals are following the general trend, with marked improvement in some cases contending with quiet conditions in other lines. As an illustration of improvement the sales of fertilizer tags for September in the principal fertilizer-consuming states were 15 per cent larger than they were in September, 1925. The leather industry also had operating more actively than was the case last year, and the same holds true of the textile industry, including rayon manufacture. On the other hand, pulp and paper production has been slower, and with large stocks on hand the prospects do not favor any immediate improvement. This situation also applies to Canadian mills, and, therefore, is a factor in the export trade of such chemicals as enter into pulp and paper manufacture. The glass trade has been quiet in recent months and recent labor troubles have not helped the situation. Automobile production has been running far behind last year's standards for the last three months, and October output promises to be relatively small, as some plants are expected to close for inventory and one manufacturer is not yet operating.

FIGURES showing actual operations in certain industries during August are now available and offer a basis of comparison for consumption of chemicals in that month and the corresponding period of 1925. The following table gives production data for the industries specified:

	August 1927	August 1926
Chemical wood pulp, ton	220,138	221,874
Plate glass, thousand sq.ft.	10,616	11,274
Mineral oil refined, thousand bbl.	71,206	67,589
Acetate of lime, thousand lb.	13,325	12,180
Methanol, crude, gal	582,710	589,828
Methanol, refined, gal	317,521	608,346
Explosives, thousand bbl.	36,304	38,023
Acid phosphate, ton	256,980	243,697
Pneumatic tires, thousands	4,334	4,411
Oleomargarine, thousand lb	20,672	15,635

The figures for oleomargarine are important because they are accompanied by the explanation that this output consumed 8,840,000 lb. of coconut oil and 1,745,000 lb. of cottonseed oil in August 1926 as against 6,190,000 lb. and 1,405,000 lb. respectively in August, 1925.

Based on indexes of employment as published by the Bureau of Labor, production of chemicals was larger in August than July although slightly less than in August, 1925. On the same authority consumption of chemicals in August was smaller than a year ago in the leather, paper and pulp, fertilizer, petroleum, glass, and tire trades. The indexes follow:

Indexes of Employment

	Aug. 1927	July 1927	Aug. 1926
Dyeing and finishing textiles	96.5	95.3	94.2
Leather	88.6	88.2	90.7
Paper and pulp	93.2	92.2	95.2
Chemicals	93.3	92.9	93.6
Fertilizers	71.7	64.5	82.6
Petroleum refining	93.5	95.7	101.6
Glass	89.4	90.3	95.9
Automobile tires	110.4	111.4	111.1
All manufacturing	87.4	87.3	90.7

ACCORDING to the Department of Commerce manufacturing production in August, after adjustment for differences in working time, showed no change from July, but was less than in August, 1926. Without adjustment in working time, all groups showed an increase in production over July, except foodstuffs, while compared with a year ago, declines were made only in iron and steel other metals, paper and printing, tobacco and miscellaneous, including automobiles. Raw-material output for August was higher than in both July, 1927, and August, 1926. All the raw-material groups, consisting of animal products, minerals, crops and forest products, showed increases in output or marketings over both periods.

The index of commodity stocks, when adjusted for normal seasonal variations, increased during August although, without adjustment, there was a decline. All groups showed increases over July in the adjusted index. Compared with a year ago, stocks also increased, all groups participating therein.

The index of unfilled orders, principally iron and steel and building materials, showed no change from the end of July, although building materials declined one point. The index declined from the end of August, 1926, both the iron-and-steel and the building-materials groups showing lower unfilled orders than a year ago.

Prices have shown a slightly easier trend but basic chemicals have held a steady course and the principal interest in prices rests in contract levels which are soon to be announced for some of the important items, including soda ash, caustic soda, bleaching powder, and liquid chlorine.

BOTH exports aggregating $17,512,000 and imports aggregating $18,683,000 of chemicals and allied products showed gains of 13 per cent and 19 per cent respectively in August, 1927, as compared with August, 1926. Again exports were less than imports. The most significant change was the high figure attained in exports of pigments, paints, and varnishes. Imports of fertilizers were up once more after the reductions of the past few months.

The value of $3,484,000 for exports of naval stores, gums, and resins in August, 1927, was 7½ per cent below August, 1926 due to the much lower price of rosin as quantities of both rosin and turpentine were greater in the current August. Exports of gum rosin were $2,050,000; of wood rosin, $249,000; of spirits of turpentine, $1,069,000; and of wood turpentine, $29,000. Imports of gums and resins were 16 per cent more than in August, 1926, and equaled $2,390,000. Varnish gums recorded a somewhat higher price than in last August.

Germany and Canada were the best customers of American sulphur each having taken one third of the total of 88,000 tons, which was 60 per cent more than in August, 1926.

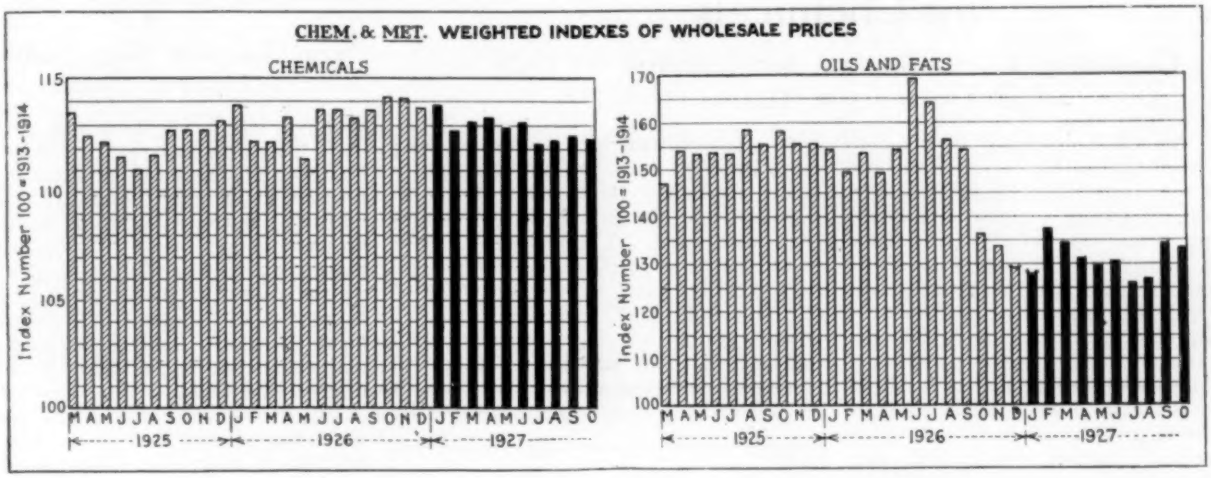
After the very small shipments of coal-tar products in July, those for August, 1927 were up again and were 18 per cent more than the preceding August equaling $1,266,000. Imports, however, were $400,000 less than August, 1926, but were $600,000 in excess of exports equaling $1,913,000. Creosote oil, as usual, was the largest import, accounting for $1,361,000. Outgoing shipments of colors, dyes and stains picked up and exceeded incoming shipments by $200,000, total for the month having been $525,000 for exports, and $421,000 for imports.

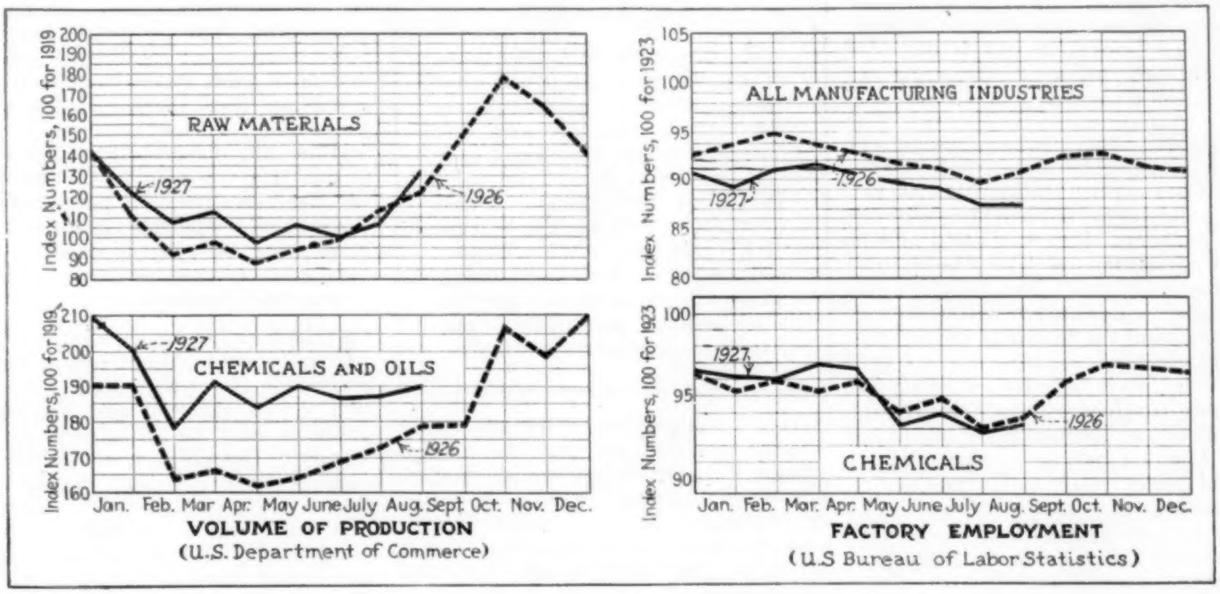
During the month of August, 1927, the exports of pigments, paints and varnishes reached a peak figure of $2,000,000. Although nearly all classes of the group recorded gains, those of chief interest were enamel paints, other ready mixed paints, other prepared paints, and varnishes other than oil and including lacquers. Carbon black continued to have a good foreign demand.

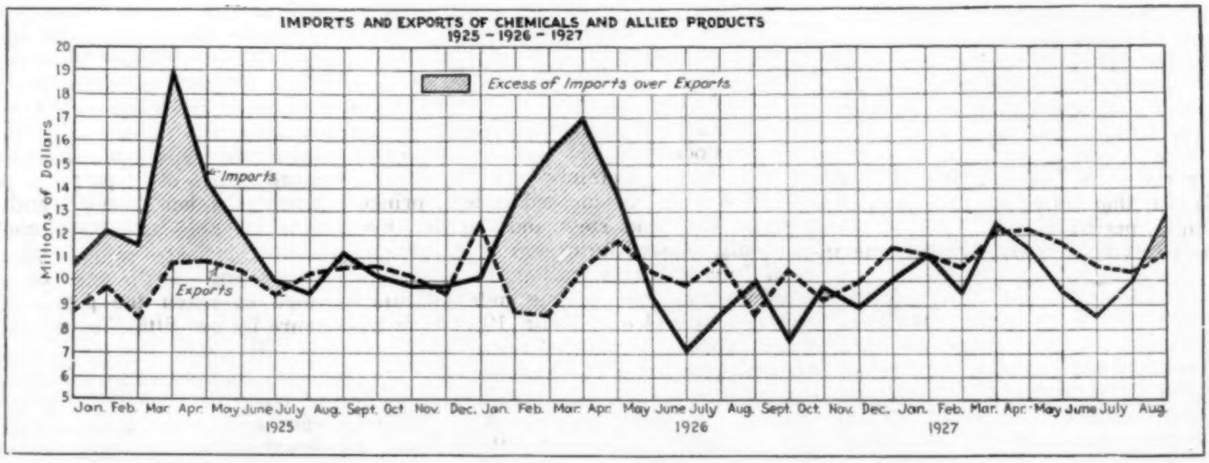
Outgoing shipments of fertilizers failed to reach the previous August's figure by one-fifth the value, being $1,325,000. One half as much ammonium sulphate was exported during this period and prepared fertilizer mixtures were also less. Slightly more superphosphates and considerably larger amounts of other fertilizers, however, were shipped.

CHEM. & MET. STATISTICS OF BUSINESS

IN THE CHEMICAL ENGINEERING INDUSTRIES







MARKET CONDITIONS *and* PRICE TRENDS

Interest Shown in Contract Prices for Chemicals

Consuming Trades Receive Announcement on 1928 Deliveries of Alkalies

WITH THE approach of the contract season for some of the important chemicals including caustic soda, soda ash, bleaching powder and liquid chlorine, there has been considerable interest shown by consumers of those chemicals relative to the price levels which will be established for delivery over the coming year. There has not been enough changes in the position of raw materials or in manufacturing costs in general to cause any radical changes from the figures which applied to 1927 contracts. However, until the new prices have been announced a feeling of uncertainty exists regarding them. The contracting period also is of interest to producers because the volume of business placed before the end of the year will give some index of consuming activity in the future.

IN SOME cases, contract buying has been in evidence and large amounts or molasses. Such competition is not monia are reported to have been sold for future delivery. Recent trading, either in spot or futures, has given no indication of price trends. The weighted index number was reduced slightly during the month and the fact that buying has been of smaller volume in the last two months has been reflected in an easier undertone to values without encouraging any belief that future values would be lower. Buying interest is now improving and under more active trading it would be logical to expect a firmer market as many chemicals have been selling at relatively low prices with supplies apparently outweighing demand. Predictions for an active market throughout the final quarter of the year are tempered by reports that certain consuming trades are not holding up to the standards of a year ago and opinions incline to the belief that total consumption of chemicals for the three-month period will not equal that of the last quarter of 1926.

Competitive Market Rules for Sal Ammoniac

KEEN COMPETITION among sellers of sal ammoniac has featured trading in this chemical for several months and recent developments have failed to improve the situation. Consuming outlets have expanded in the last few years and the increased demand for supplies has encouraged larger domestic production and has invited increased shipments from foreign markets. Apparently production here and abroad has increased even more rapidly than consuming requirements as sellers have been more aggressive and the trend of prices has been downward. A lowering in prices in the last two years might be regarded as logical in view of the lower price of important raw materials but the recent status of the market would indicate that the margin of profit to producers is being drawn very fine in an effort to obtain control of the market. Competition rests principally between the domestic and the foreign product. In the eight-month period, Jan.-Aug. this year, imports amounted to 10,006,295 lb. as compared with 8,046,061 lb. in the corresponding period of 1926. In other words, imported material has been gaining ground in our consuming markets. In some cases consumers have given preference to foreign-made sal ammoniac even when there was no price inducement but demand undoubtedly has been stimulated by price considerations. Reports have circulated recently to the effect that white sal ammoniac of foreign origin was offered under 5c. per lb. on an ex-dock basis. Domestic material also has shown an easier price trend with reports that sales have been made at 5c. per lb. f.o.b. works and other producers have been willing to accept orders very close to the 5c. per lb. figure. Interest in trade circles revolves about the future course of the market with especial reference to the continuance of active competition from abroad. In some quarters it is held that domestic producers are making headway at the expense of importers and that future shipments from European markets will be of diminishing volume, but uncertainty regarding producing costs abroad makes it difficult to gage the extent to which foreign markets may compete.

Contract Prices Named for Alkalies

As *Chem. & Met.* was going to press announcement was made of new and lower contract prices for caustic soda and soda ash. The new prices are: Light soda ash, in bulk, \$1.15; in bags, \$1.32; in bbl., \$1.55. Dense soda ash, in bulk \$1.22½; in bags, \$1.37½; in bbl., \$1.55. Caustic soda, \$2.90; caustic soda flakes, \$3.40. These prices are for contract business, per 100 lb. in carlots, f.o.b. producers works.

New Factors May Influence Alcohol Prices

ONE OF THE disturbing factors in the alcohol market in recent years has been the large overproduction which brought about selling pressure and price cutting. Surplus stocks in widely distributed hands made it impossible to maintain anything like stable quotations. More recently the market reverted largely to the control of producers and sales schedules have been fairly well maintained although second hands still offer competition.

The announcement that production of industrial alcohol in 1928 will be regulated so as to keep it within the bounds of legitimate consuming needs gives promise of eliminating surplus stocks and of stabilizing prices. In the fiscal year ended June 30, production of alcohol was about 90,000,000 gal. or a decline of about 26,000,000 gal. from the preceding fiscal year. If the rate of production is further cut down this year, and the output for the first nine months of this year was considerably below that for the corresponding period of 1927, the outlook would favor a stable market with prices varying according to production costs and not to the influence of distressed holdings

THAT higher prices must necessarily follow the cutting down of domestic production is not so evident. The position of raw materials and of competing products may be prominent as price factors. The position of molasses has caused much comment during recent weeks. In some quarters it was stated that there was a decidedly downward trend to the market for molasses. In fact reports were circulated to the effect that sales had been made around 4½c. per gal. at Cuban shipping points. It was also stated that sales of South American molasses had been negotiated at relatively low prices. The open quotation is 7c. per gal. at Cuban ports and different interests maintain that this is a firm price and they refuse to credit reports that the market is declining in price or that sales have been made recently below the 7c. level.

While sales of alcohol are reported to be of satisfactory volume, competing materials also are said to have sold freely especially in the anti-freeze trade. Among competing materials, attention is being given to the possibility that future production of alcohol from ethylene may compete keenly with alcohol made from the fermentation of grain or molasses. Such competition is not expected to be important in the near future at least and contract prices for alcohol for next years delivery would seem to depend largely on the prices paid for molasses.

MARKET CONDITIONS *and* PRICE TRENDS

Fertilizer Trade Consumes Less Sulphuric Acid

THE DEPARTMENT of Commerce has just issued a report on its semi-annual canvass of the fertilizer trade and finds that consumption and production of sulphuric acid in that industry during the first half of this year was considerably smaller than in the corresponding period of 1926.

During the 6-month period this year the fertilizer industry produced 779,079 tons of sulphuric acid and consumed 853,888 tons in the manufacture of 1,563,700 tons of acid phosphates containing 26,893,000 units (of 20 lbs.) of available phosphoric acid. The production of sulphuric acid by fertilizer manufacturers was thus equal to 91.2 per cent of their total consumption. Acid phosphates sold as such amounted to 1,107,014 tons, containing 18,758,000 units of available phosphoric acid; and 1,299,254 tons of acid phosphates, containing 21,350,000 units, were consumed in the manufacture of other fertilizers.

The statistics for the first half of 1927 as compared with those for the first half of 1926 show decreases of 21.6 per cent in production of acid phosphates and 6.3 per cent in total sales of acid phosphates, an increase of 7.6 per cent in stocks of sulphuric acid on hand at the end of the period, and a decrease of 13.1 per cent in stocks of acid phosphates.

Detailed reports on sulphuric acid production and consumption in the fertilizer trade for the first 6 months of the year are given in the accompanying table, and figures for the first and second halves of 1926 also are included.

Sulphuric Acid Production in Fertilizer Industry Jan.-June, 1927 *

	1927	1926	
	1st Half Jan.-June	2nd Half July-Dec.	1st Half Jan.-June
	Tons	Tons	Tons
Stocks on hand at beginning of period	97,043	86,247	101,416
Produced in establishments reporting	779,079	810,326	935,433
Purchased	266,911	413,836	378,415
Total	1,143,033	1,310,409	1,415,264
Consumed in making fertilizers	853,888	972,806	1,085,877
Sales:			
To fertilizer works	117,201	155,079	151,232
To other than fertilizer works	82,217	89,393	94,761
Stocks on hand at end of period	89,727	93,131	83,394

Higher Estimate for Yield of Flaxseed

ON OCTOBER 10, the government issued a report on the condition of the flaxseed crop, as of October 1. The report showed that weather conditions throughout the growing period had been favorable and estimates on the yield per acre have been revised upward in all of the monthly reports issued since the July report. The current estimate placed condition at 84.4 per cent, yield per acre at 9.1 bu. and total yield at 24,300,000 bu. As the final report on the 1926 crop placed total yield at 19,459,000 bu., it becomes evident that the present crop will furnish a supply almost 5,000,000 bu. larger than that of last year and, therefore, will cut down our import requirements for the coming year. As total consumption of flaxseed in this country approximates 40,000,000 bu. it is equally evident that the domestic crop will not take care of these requirements.

WITH so large a part of domestic needs to be filled by importations, the price movement for seed at Duluth will be influenced largely by the Buenos Aires market which in turn will reflect the position of the world's consuming markets for linseed oil. The domestic crop of seed has been moved in large volume since September 1, receipts at western markets having reached a total of 9,691,000 bu. up to the end of last week. This has exerted a bearish influence on prices for oil and contract business has been placed on a basis of 10c. per lb. This may be regarded as a relatively low price for linseed oil but many buyers have been holding off for further price declines, influenced by the knowledge that there had been an increase in the domestic seed supply this year. It is possible that domestic seed receipts in the next six weeks will bring about lower prices for oil but after the close of inland water navigation early in December, the market usually advances in price. The most important factor on future prices, however, is found in the volume of the Argentine seed crop. It is too early to obtain definite information on this point but it is necessary for a large crop to be harvested if oil prices in all markets are to be kept from advancing. Old crop Argentine seed has been well absorbed and the exportable surplus as of October 1 was reported at 6,240,000 bu. as compared with 15,000,000 bu. at the corresponding period last year.

Exports of Chemicals

	August 1927	August 1926
Benzol, gal	2,422,390	1,512,129
Crude coal-tar and pitch, bbl.	10,466	16,344
Acid, sulphuric, lb.	517,346	598,156
Other acids, lb	856,280	608,370
Methanol, gal.	18,796	43,350
Ammonia and compounds, lb.	307,288	283,672
Aluminum sulphate, lb.	3,850,770	3,365,183
Acetate of lime, lb.	282,650	2,901,988
Calcium carbide, lb.	490,503	273,415
Bleaching powder, lb.	2,260,430	1,344,859
Copper sulphate, lb.	375,462	527,017
Formaldehyde, lb.	47,720	103,815
Potassium compounds, lb.	222,441	118,926
Sodium bichromate, lb.	466,807	573,059
Sodium cyanide, lb.	71,583	65,411
Borax, lb.	6,948,731	1,167,596
Sodium silicate, lb.	5,391,993	3,856,922
Sal soda, lb.	1,251,637	1,356,688
Caustic soda, lb.	5,540,275	5,917,409
Bicarbonate of soda, lb.	1,498,929	1,290,597
Sulphate of ammonia, ton	7,024	14,167
Sulphur, ton	88,033	61,012

Imports of Chemicals

	August 1927	August 1926
Dead or creosote oil, gal.	8,340,107	10,682,167
Pyridine, lb.	....	67,325
Coal-tar acids, lb.	8,526	51,352
Coal-tar intermediates, lb.	100,622	97,109
Arsenic, lb.	2,209,977	1,269,567
Acid, citric, lb	....	15,120
Acid, formic, lb.	131,373	76,573
Acid, oxalic, lb.	145,121	38,089
Acid, sulphuric, lb.	1,882,760	4,691,486
Acid, tartaric, lb.	174,496	209,092
Ammonium chloride, lb.	757,148	958,261
Ammonium nitrate, lb.	871,635	623,616
Barium compounds, lb.	640,794	1,332,801
Calcium carbide, lb.	52,000	904,986
Cobalt oxide, lb.	13,050	5,000
Copper sulphate, lb.	46,237	....
Bleaching powder, lb.	125,740	146,634
Lime citrate, lb.	....	272,788
Glycerine, crude, lb.	2,036,247	4,240,017
Glycerine, refined, lb.	803,866	1,467,333
Magnesium compounds, lb.	2,457,746	2,157,873
Potassium cyanide, lb.	2,536	12,180
Potassium carbonate, lb.	1,158,790	751,556
Potassium nitrate, ton	116	....
Caustic potash, lb.	1,273,523	559,458
Cream of tartar, lb.	5,600	11,200
Potassium chlorate, lb.	1,042,791	764,153
Sodium cyanide, lb.	2,727,468	2,476,190
Sodium ferrocyanide, lb.	226,921	33,471
Sodium nitrate, lb.	11,014	26,846
Sodium nitrate, ton	71,904	55,325
Sulphate of ammonia, ton	521	242

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	**112.39**
Last month	112.55
October, 1926	114.17
October, 1925	112.79

While the majority of important chemicals were unchanged in price, there was some price setting without any open change in sales schedules. Formaldehyde was openly reduced one-half cent per lb. and aided in the downward revision of the weighted index number.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	**133.77**
Last month	134.48
October, 1926	135.71
October, 1925	158.21

Crude cottonseed oil showed an advancing tendency earlier in the month but eased off and with lower prices for linseed oil the index number was lowered slightly. Cocoanut, castor, sulphur, and menhaden oils were higher for the period.

CURRENT PRICES
in the NEW YORK MARKET

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to October 15.

Industrial Chemicals

		Current Price	Last Month	Last Year
Acetone, drums	lb.	$0.12 -$0.13	$0.12 -$0.13	$0.12 -$0.13
Acid, acetic, 28%, bbl.	cwt.	3.38 - 3.63	3.38 - 3.63	3.25 - 3.50
Boric, bbl	lb.	.08½- .08¾	.08½- .08¾	.08½- .11
Citric, kegs	lb.	.44½- .45	.44½- .45	.45 - .47
Formic, bbl.	lb.	.11 - .12	.10½- .11	.10½- .11
Gallic, tech., bbl	lb.	.50 - .55	.50 - .55	.45 - .50
Hydrofluoric 30% carb.	lb.	.06 - .07	.06 - .07	.06 - .07
Lactic, 44%, tech., light, bbl.	lb.	.13½- .14	.13½- .14	.13½- .14
22%, tech., light, bbl.	lb.	.06½- .07	.06½- .07	.06½- .07
Muriatic, 18°, tanks	cwt.	.85 - .90	.85 - .90	.85 - .90
Nitric, 36°, carboys	cwt.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks.	ton	18.00 -20.00	18.00 -20.00	18.00- 20.00
Oxalic, crystals, bbl.	lb.	.11 - .11½	.11 - .11½	.10½- .11
Phosphoric, tech., c'bys.	lb.	.07 - .07½	.07 - .07½	.07 - .07½
Sulphuric, 60°, tanks	ton	10.50 -11.00	10.50 -11.00	10.50 -11.00
Tannic, tech., bbl	lb.	.35 - .40	.35 - .40	.35 - .40
Tartaric, powd., bbl.	lb.	.37 - .37½	.37 - .37½	.29 - .30
Tungstic, bbl.	lb.	1.00 - 1.20	1.00 - 1.20	1.00 - 1.20
Alcohol, ethyl, 190 p'f. U.S.P. bbl.	gal.	3.75 - 4.00	3.75 - 4.00	4.85 - 4.90
Alcohol, Butyl, dr.	lb.	.19½- .20½	.19½- .20½	.18½- .19
Denatured, 190 proof				
No. 1 special dr.	gal.	.48 -......	.48	.31 -......
No. 5, 188 proof, dr.	gal.	.48 -......	.48	.31 - .32
Alum, ammonia, lump, bbl.	lb.	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl.	lb.	.05½- .05¾	.05½- .05¾	.05½- .06
Potash, lump, bbl.	lb.	.02¾- .03½	.02¾- .03½	.02¾- .03½
Aluminum sulphate, com., bags	cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg.	cwt.	2.00 - 2.10	2.00 - 2.10	2.40 - 2.45
Aqua ammonia, 26°, drums.	lb.	.02½- .03	.02½- .03½	.03½- .04
Ammonia, anhydrous, cyl.	lb.	.11 - .13	.11 - .15	.13 - .15
Ammonium carbonate, powd. tech., casks	lb.	.10½- .14	.10½- .14	.11 - .14
Sulphate, wks.	cwt.	2.25 -......	2.25 -......	2.50 -......
Amylacetate tech., drums	gal.	2.15 - 2.20	2.15 - 2.20	1.80 - 1.90
Antimony Oxide, bbl.	lb.	.16 - .16½	.16 - .17½	.14½- .15
Arsenic, white, powd., bbl.	lb.	.04 - .04½	.04 - .04½	.03¾- .04½
Red, powd., kegs	lb.	.09½- .10	.09½- .10	.11 - .12
Barium carbonate, bbl.	ton	52.00 -54.00	50.00 -52.00	48.00 -50.00
Chloride, bbl.	ton	60.00 -62.00	58.00 -60.00	63.00 -65.00
Nitrate, cask	lb.	.08 - .08½	.08 - .08½	.07½- .08
Blanc fixe, dry, bbl.	lb.	.04 - .04½	.04 - .04½	.04 - .04½
Bleaching powder, f.o.b., wks., drums	cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl.	lb.	.04½- .04¾	.04½- .05	.05 - .05½
Bromine, cs.	lb.	.45 - .47	.45 - .47	.45 - .47
Calcium acetate, bags	cwt.	3.50 -......	3.50 -......	3.25 - 3.50
Arsenate, dr.	lb.	.07 - .08	.07½- .08	.07½- .08
Carbide drums	lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks.	ton	21.00 -......	21.00 -......	21.00 -......
Phosphate, bbl.	lb.	.07 - .07½	.07 - .07½	.07 - .07½
Carbon bisulphide, drums	lb.	.05½- .06	.05½- .06	.05½- .06
Tetrachloride drums	lb.	.06½- .07	.06½- .07	.06½- .07
Chlorine, liquid, tanks, wks.	lb.	.04 - .04½	.04 - .04½	.04 - .04½
Cylinders	lb.	.05½- .08	.05½- .08	.05½- .08
Cobalt oxide, cans	lb.	2.00 - 2.10	2.00 - 2.10	2.10 - 2.25
Copperas, bgs., f.o.b. wks.	ton	14.00 -17.00	14.00- 17.00	13.00 -15.00
Copper carbonate, bbl.	lb.	.16½- .17½	.17 - .18	.16½- .17
Cyanide, tech., bbl.	lb.	.49 - .50	.49 - .50	.49 - .50
Sulphate, bbl.	cwt.	5.00 - 5.10	5.00 - 5.10	4.90 - 5.00
Cream of tartar, bbl.	lb	.27½- .28	.27½- .28	.21 - .22
Epsom salt, dom., tech., bbl.	cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags	cwt.	1.15 - 1.25	1.15 - 1.25	1.35 - 1.40
Ethyl acetate, 85% drums	gal.	.74 - .76	.74 - .76	.74 - .76
99%, dr.	gal.	.87 - .88	.87 - .88	.98 - 1.04
Formaldehyde, 40%, bbl.	lb.	.08½- .08½	.08½- .11	.09 - .09½
Furfural, dr.	lb.	.15 - .17½	.15 - .17½	.15 - .17
Fusel oil, crude, drums	gal.	1.30 - 1.40	1.30 - 1.40	1.40 - 1.50
Refined, dr.	gal.	2.50 - 3.00	2.50 - 3.00	2.50 - 3.00
Glaubers salt, bags	cwt.	1.00 - 1.15	1.00 - 1.10	1.20 - 1.40
Glycerine, c.p., drums, extra	lb.	.23 - .24	.23 - .24	.30 -......
Lead:				
White, basic carbonate, dry, casks	lb.	.09 -......	.09 -......	.10½-......
White, basic sulphate, sck.	lb.	.08½-......	.08½-......	.09½-......
Red, dry, sck.	lb.	.09½-......	.10½-......	.11½-......
Lead acetate, white crys., bbl.	lb.	.13 - .13½	.13 - .13½	.14½-......
Lead arsenate, powd., bbl.	lb.	.12 - .13	.12 - .13	.14 - .15
Lime, chem., bulk	ton	8.50 -......	8.50 -......	8.50 -......
Litharge, pwd., csk.	lb.	.08½-......	.09½-......	.11½-......
Lithopone, bags	lb.	.05½- .06	.05½- .06	.05½- .06½
Magnesium carb., tech., bags	lb.	.07½- .08	.07½- .08	.06½- .06½
Methanol, 95%, dr.	gal.	.53 -...55	.55 -......	.70 - .72
97%, dr.	gal.	.55 -......	.55 -......	.72 - .74
Nickel salt, double, bbl.	lb.	.10 - .10½	.10 - .10½	.09 - .10
Single, bbl.	lb.	.10½- .11	.10½- .11	.10 - .11

		Current Price	Last Month	Last Year
Orange mineral, csk.	lb.	.11½-......	.12 -......	.13½-......
Phosphorus, red, cases	lb.	.62 - .65	.62 - .65	.65 - .68
Yellow, cases	lb.	.32 - .33	.32 - .34	.33 - .34
Potassium bichromate, casks	lb.	.08½- .08½	.08½- .08½	.08½- .08½
Carbonate, 80-85%, calc., csk.	lb	.05½- .06	.05½- .06	.06 - .06½
Chlorate, powd.	lb.	.08½- .09	.08½- .09	.08½- .09
Cyanide, cs.	lb.	.55 - .57	.55 - .58	.55 - .57
First sorts, csk.	lb.	.09 - .09½	.08½- .09	.08½- .09
Hydroxide (c'stic potash) dr.	lb.	.07½- .07½	.07½- .07½	.07½- .07½
Muriate, 80% bgs.	ton	36.40 -......	36.40 -......	34.90 -......
Nitrate, bbl.	lb.	.06 - .06½	.06 - .06½	.06 - .07½
Permanganate, drums	lb.	.14 - .15	.14 - .15	.14½- .15
Prussiate, yellow, casks	lb.	.18½- .19	.18½- .19	.18 - .19
Sal ammoniac, white, casks	lb.	.05½- .06	.05½- .06½	.05½- .06
Salsoda, bbl.	cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk	ton	17.00 -18.00	17.00 -18.00	17.00 -19.00
Soda ash, light, 58%, bags, contract	cwt.	1.32½-......	1.32½-......	1.38 -......
Dense, bags	cwt.	1.37½-......	1.37½- 1.55	1.45 - 1.55
Soda, caustic, 76%, solid, drums, contract	cwt.	3.00 -......	3.00 -......	3.10 -......
Acetate, works, bbl.	lb.	.04½- .05½	.04½- .05	.04½- .05
Bicarbonate, bbl.	cwt.	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Bichromate, casks	lb.	.06½- .06½	.06½- .06½	.06½- .06½
Bisulphate, bulk	ton	5.00 - 5.50	5.00 - 5.50	6.00 - 7.00
Bisulphite, bbl.	lb.	.03½- .04	.03½- .04	.03½- .04
Chlorate, kegs	lb.	.06½- .06½	.06½- .06½	.06½- .06½
Chloride, tech.	ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom.	lb.	.18 - .22	.18 - .22	.19 - .22
Fluoride, bbl.	lb.	.08½- .09	.08½- .09	.08½- .09
Hyposulphite, bbl.	lb.	2.50 - 3.00	2.50 - 3.00	2.65 - 3.00
Nitrate, bags	cwt.	2.32½-......	2.30 -......	2.36 -......
Nitrite, casks	lb.	.08½- .08½	.08½- .08½	.08½- .09
Phosphate, dibasic, bbl.	lb.	.03½- .03½	.03½- .03½	.03½- .03½
Prussiate, yel. drums	lb.	.12 - .12½	.12 - .12½	.10 - .10½
Silicate (30°, drums)	cwt.	.75 - 1.15	.75 - 1.15	.75 - 1.15
Sulphide, fused, 60-62%, dr.	lb.	.03½- .04	.03½- .04	.02½- .03
Sulphite, crys., bbl.	lb.	.03 - .03½	.03 - .03½	.02½- .03
Strontium nitrate, bbl.	lb.	.08½- .09	.08½- .09	.08½- .09
Sulphur, crude at mine, bulk	ton	19.00 -......	19.00 -......	19.00 -20.00
Chloride, dr.	lb.	.04 - .05	.04 - .05	.05 - .05½
Dioxide, cyl.	lb.	.09 - .10	.09 - .10	.09 - .10
Flour, bag	cwt.	2.70 - 3.00	2.70 - 3.00	2.70 - 3.00
Tin bichloride, bbl.	lb.	.17½-......	.18½-......	.19 -......
Oxide, bbl.	lb.	.64 -......	.66 -......	.67 -......
Crystals, bbl.	lb.	.42 -......	.44½-......	.48 -......
Zinc chloride, gran., bbl.	lb.	.06½- .06½	.06½- .06½	.07 - .07½
Carbonate, bbl.	lb.	.10 - .11	.10 - .10½	.10½- .11
Cyanide, dr.	lb.	.40 - .41	.40 - .41	.40 - .41
Dust, bbl.	lb.	.09 - .10	.10½- .11	.09 - .10
Zinc oxide, lead free, bag.	lb.	.06½-......	.06½......	.07½-......
5% lead sulphate, bags	lb.	.06½-......	.06 -......	.07½-......
Sulphate, bbl.	cwt.	2.75 - 3.00	2.75 - 3.00	2.75 - 3.00

Oils and Fats

		Current Price	Last Month	Last Year
Castor oil, No. 3, bbl.	lb.	$0.13 -$0.13	$0.12½-$0.13	$0.12½-$0.13
Chinawood oil, bbl.	lb.	.15 -......	.17½-......	.17½-......
Coconut oil, Ceylon, tanks, N. Y.	lb.	.08½-......	.08½-......	.10 -......
Corn oil crude, tanks, (f.o.b. mill)	lb.	.10 -......	.10 -......	.11½-......
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.09½-......	.10 -......	nom. -......
Linseed oil, raw, car lots, bbl.	lb.	.101 -......	.104 -......	.108 -......
Palm, Lagos, casks	lb.	.07½-......	.07½- .08	.08½-......
Niger, casks	lb.	.07½-......	.07½- .07½	.08½-......
Palm Kernel, bbl.	lb.	.09 -......	.08½-......	.10½-......
Peanut oil, crude, tanks (mill)	lb.	.10 -......	.11 -......	.13 -......
Perilla, bbl.	lb.	....-......	....-......	....-......
Rapeseed oil, refined, bbl.	gal.	.85 - .86	.85 - .86	.84 - .86
Sesame, bbl.	lb.	....-......	....-......	....-......
Soya bean tank (f.o.b. Coast)	lb.	.09½-......	.09½-......	.10½-......
Sulphur (olive foots), bbl.	lb.	.09½-......	.08½-......	.08½-......
Cod, Newfoundland, bbl.	gal.	.63 - .62	.63 - .64	.60 - .65
Menhaden, light pressed, bbl.	gal.	.60 - .66	.60 - .62	.65 - .68
Crude, tanks (f.o.b. factory)	gal.	.46 -......	.45 -......	.47½-......
Whale, crude, tanks	lb.	....-......	....-......	....-......
Grease, yellow, loose	lb.	.06½-......	.06½-......	.08½-......
Oleo stearine.	lb.	.12½-......	.10½-......	.12½-......
Red oil, distilled, d.p. bbl.	lb.	.09½- .09½	.09½- .10	.10 - .10½
Tallow, extra, loose	lb.	.08 -......	.07½-......	.08½-......

Coal-Tar Products

		Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl.	lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl.	lb.	.85 - .90	.85 - .90	.85 - .90
Alpha-naphthylamine, bbl.	lb.	.35 - .36	.35 - .36	.35 - .36
Aniline oil, drums, extra	lb.	.15 - .16	.15 - .16	.16 - .16½
Aniline salts, bbl.	lb.	.24 - .25	.24 - .25	.22 - .23
Anthracene, 80%, drums	lb.	.60 - .65	.60 - .65	.60 - .65

Coal Tar Products (Continued)

		Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr.	lb.	$1.15 -$1.25	$1.15 -$1.35	$1.30 -$1.35
Benzidine base, bbl.	lb.	.70 - .72	.70 - .75	.72 - .74
Benzoic acid, U.S.P., kgs.	lb.	.58 - .60	.58 - .60	.56 - .60
Benzyl chloride, tech, dr	lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works	gal.	.24 - .25	.24 - .25	.25 - .26
Beta-naphthol, tech., drums	lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr.	lb.	.18 - .20	.18 - .20	.18 - .20
Cresylic acid, 97%, dr., wks.	gal.	.61 - .62	.61 - .62	.60 - .65
Diethylaniline, dr	lb.	.58 - .60	.58 - .60	.58 - .60
Dinitrophenol, bbl.	lb.	.31 - .35	.31 - .33	.31 - .35
Dinitrotoluen, bbl	lb.	.17 - .18	.17 - .18	.18 - .20
Dip oil, 25% dr	gal.	.28 - .30	.28 - .30	.28 - .30
Diphenylamine, bbl.	lb.	.45 - .47	.45 - .47	.48 - .50
H-acid, bbl.	lb.	.63 - .65	.63 - .65	.65 - .66
Naphthalene, flake, bbl.	lb.	.04½- .05	.04½- .05	.06½- .07
Nitrobenzene, dr	lb.	.09 - .10	.09 - .10	.09 - .10
Para-nitraniline, bbl	lb.	.52 - .53	.52 - .53	.50 - .53
Para-nitrotoluine, bbl.	lb.	.28 - .32	.28 - .32	.40 - .42
Phenol, U.S.P., drums	lb.	.18 - .19	.18 - .19	.22 - .24
Picric acid, bbl.	lb.	.30 - .40	.30 - .40	.25 - .26
Pyridine, dr	lb.	3.00 -......	3.00 -......	3.90 - 4.00
R-salt, bbl.	lb.	.47 - .50	.47 - .50	.50 - .55
Resorcinal, tech, kegs.	lb.	1.30 - 1.35	1.35 - 1.40	1.30 - 1.40
Salicylic acid, tech., bbl.	lb.	.30 - .32	.30 - .32	.32 - .33
Solvent naphtha, w.w., tanks	gal.	.35 -......	.35 -......	.35 -......
Tolidine, bbl.	lb.	.95 - .95	.95 - .96	.90 - .95
Toluene, tanks, works	gal.	.35 -......	.35 -......	.35 -......
Xylene, com., tanks	gal.	.36 - .41	.36 - .41	.36 - .40

Miscellaneous

		Current Price	Last Month	Last Year
Barytes, grd., white, bbl.	ton	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl.	lb.	.17½- .18	.17 - .18	.17½- .18
China clay, dom., f.o.b. mine	ton	10.00 -20.00	10.00 -20.00	10.00 -20.00
Dry colors:				
Carbon gas, black (wks.)	lb.	.06½- .07	.06½- .07	.08 - .08½
Prussian blue, bbl.	lb.	.33 - .34	.33 - .34	.32 - .33
Ultramine blue, bbl.	lb.	.08 - .35	.08 - .35	.08 - .35
Chrome green, bbl.	lb.	.27 - .31	.27 - .30	.28 - .30
Carmine red, tins	lb.	5.50 - 5.75	5.50 - 5.75	5.10 - 5.85
Para toner	lb.	.80 - .90	.80 - .90	.90 - .95
Vermilion, English, bbl.	lb.	1.80 - 1.85	1.80 - 1.85	1.45 - 1.50
Chrome yellow, C. P., bbl.	lb.	.17 - .18	.17 - .18	.17½- .18
Feldspar, No. 1 (f.o.b. N. C.)	ton	5.75 - 7.00	5.75 - 7.00	6.00 - 6.50
Graphite, Ceylon, lump, bbl.	lb.	.07½- .08	.07½- .09½	.09 - .10
Gum copal, Congo, bags	lb.	.09½- .10	.09½- .10	.09½- .10
Manila, bags	lb.	.15 - .18	.15 - .16	.14 - .10
Damar, Batavia, cases	lb.	.25 - .25½	.25 - .26	.25 - .25
Kauri, No. 1 cases	lb.	.55 - .57	.55 - .57	.58 - .62
Kieselguhr (f.o.b. N. Y.)	ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc.	ton	44.00 -......	44.00 -......	38.00 -42.00
Pumice stone, lump, bbl.	lb.	.05 - .07	.05 - .08	.04½- .06
Imported, casks	lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H.	bbl.	9.10 -......	10.25 -......	15.40 -......
Turpentine	gal.	.54 -......	.57 -......	.94 -......
Shellac, orange, fine, bags	lb.	.52 - .53	.52 - .53	.48 - .50
Bleached, bonedry, bags	lb.	.55 - .58	.55 - .58	.48 - .50
T. N. bags	lb.	.48 - .49	.48 - .49	.39 - .41
Soapstone (f.o.b. Vt.), bags	ton	10.00 -12.00	10.00 -12.00	9.00 -11.00
Talc, 200 mesh (f.o.b. Vt.)	ton	10.50 -......	10.50 -......	10.50 -......
200 mesh (f.o.b. Ga.)	ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
325 mesh (f.o.b. N. Y.)	ton	13.75 -......	13.75 -......	14.75 -......

		Current Price	Last Month	Last Year
Wax, Bayberry, bbl.	lb.	$0.22 -$0.26	$0.23 -$0.26	$0.20 -$0.21
Beeswax, ref., light	lb.	.43 - .45	.43 - .47	.46 - .47
Candelilla, bags	lb.	.27 - .28	.27 - .28	.36 - .37
Carnauba, No. 1, bags	lb.	.62 - .62	.62 - .62	.62 - .62
Paraffine, crude 105-110 m.p.	lb	.05½- .06	.05½- .06	.05½- .06

Ferro-Alloys

		Current Price	Last Month	Last Year
Ferrotitanium, 15-18%	ton	$200.00-.....	$200.00-.....	$200.00-.....
Ferrochromium, 1-2%	lb.	.23- .25	.23- .35	.23-.....
Ferromanganese, 78-82%	ton	90.00-.....	90.00-.....	88.00-90.00
Spiegeleisen, 19-21%	ton	33.00-35.00	33.00-35.00	33.00-34.00
Ferrosilicon, 10-12%	ton	33.00-38.00	33.00-38.00	33.00-38.00
Ferrotungsten, 70-80%	lb.	.95- 1.00	.95- 1.00	1.05- 1.10
Ferro-uranium, 35-50%	lb.	4.50-.....	4.50-.....	4.50-.....
Ferrovanadium, 30-40%	lb.	3.15- 3.75	3.15- 4.00	3.25- 3.75

Non-Ferrous Metals

		Current Price	Last Month	Last Year
Copper, electrolytic	lb.	$0.13½-......	$0.1331-......	$0.14½-......
Aluminum, 96-99%	lb.	.26 - .28	.26 - .27	.27 - .28
Antimony, Chin. and Jap.	lb.	.12 - .12½	.12 - .12½	.15½- .16
Nickel, 99%	lb.	.35 -......	.35 -......	.35 -......
Monel metal, blocks	lb.	.32 - .33	.32 - .33	.32 - .33
Tin, 5-ton lots, Straits	lb.	.57⅞-......	.63⅞-......	.64½-......
Lead, New York, spot	lb.	6.25 -......	6.25 -......	8.40 -......
Zinc, New York, spot	lb.	6.45 -......	6.60 -......	7.65 -......
Silver, commercial	oz.	.57⅞-......	.57⅞-......	.63⅞-......
Cadmium	lb.	.60 -......	.60 -......	.60 -......
Bismuth, ton lots	lb.	1.85 - 2.10	2.20 - 2.25	2.70 - 2.75
Cobalt	lb.	2.50 -......	2.50 -......	3.00
Magnesium, ingots, 99%	lb.	.75 - .80	.75 - .80	.75 - .80
Platinum, ref.	oz.	72.00-......	72.00-......	111.00-......
Palladium, ref.	oz.	53.00- 54.00	59.00- 63.00	69.00-71.00
Mercury, flask	75 lb.	127.00-......	121.00-......	99.50-......
Tungsten powder	lb.	1.05- 1.15	1.05-......	1.10-......

Ores and Semi-finished Products

		Current Price	Last Month	Last Year
Bauxite, crushed, wks.	ton	$5.50- $8.50	$5.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post	ton	22.00- 24.00	22.00- 24.00	22.00- 23.00
Coke, fdry., f.o.b. ovens	ton	3.75- 4.25	3.75- 4.25	3.75- 4.25
Fluorspar, gravel, f.o.b. Ill.	ton	17.00- 18.00	17.00-......	18.00-......
Ilmenite, 52% TiO_2, Va.	lb.	.00¾ .00¾	.00¾ .00¾	.01½-......
Manganese ore, 50% Mn., c.i.f. Atlantic Ports	unit	.36 - .38	.36 - .38	.40 - .42
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y.	lb.	.48 - .50	.48 - .50	.65- .70
Monazite, 6% of ThO_2	ton	120.00-......	120.00-......	120.00-......
Pyrites, Span. fines, c.i.f.	unit	.13½-......	.13½-......	.13½-......
Rutile, 94-96% TiO_2	lb.	.11 - .13	.11 - .13	.12 - .15
Tungsten, scheelite, 60% WO_3 and over	unit	11.25 -11.50	11.25 -11.50	12.50 -13.00
Vanadium ore, per lb. V_2O_5	lb.	.25 - .28	.25 - .30	.30 - .35
Zircon, 99%	lb.	.03 -......	.03 -......	.03 -......

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Acid Plant—National Zinc Co., Bartlesville, Okla., will soon receive bids for the construction of a new acid plant. Estimated cost $600,000. Private plans. Machinery and equipment will be required.

Aluminum Factory — Leyse Aluminum Co., A. Leyse, Mgr., Kewaunee, Wis., will build a 2 story, 56 x 97 ft. aluminum factory by day labor. Private plans.

Bottling Plant — Navis Bottling Co., Goldsboro, N. C., has acquired a building and plans the installation of a bottling plant with equipment to cost $100,000.

Brass Foundry — Grimes Co., Bluffton, Ind., is having plans prepared for the construction of a brass foundry, etc. Estimated cost $43,000. Private plans.

Brass Plant Addition — Chaplin Fulton Mfg. Co., 36 Penn Ave., Pittsburgh, Pa., awarded contract for the construction of a 3 story, 60 x 100 ft. addition to brass plant to Taylor Meyer Co., Keystone Bldg., Pittsburgh, Pa. Estimated cost $40,000.

Brick Plant—East Angus Brick Co. Ltd., East Angus, Que., plans the construction of a brick plant. Complete machinery and equipment for the manufacture of brick and cement block will be required.

Brick Plant Equipment—Hanover Brick Co., 63 Ruggery Bldg., D. Lehman, Secy., Columbus, O., plans to purchase complete equipment including three presses, two dryers, conveying machinery, etc., for proposed 1 story brick factory at Hanover, O., to replace fire loss. Estimated cost $100,000.

Brick and Hollow Tile Plant—Pan-Tex Clay Products Co., A. H. Lowey, Oliver-Eackle Bldg., Amarillo, Tex., plans the construction of a brick and hollow tile plant. Estimated cost including equipment $75,000. Private plans.

Brick and Tile—A. W. O'Hare & F. H. Covert, Hamilton, Tex., plans the construction of a brick and tile plant at Nacogdoches, Tex. Estimated cost including equipment $300,000.

Brick and Tile Plants—Sinclair & Shane Co., Weslaco, Tex., will soon receive bids for the construction of brick and tile plants at Weslaco and Harlingen, Tex. Estimated cost $35,000 to $45,000 each. Private plans.

Canning and Packing Plant — Texas Citrus Fruit Growers Exchange, c/o J. Shary, Brownsville, Tex., has acquired a site and plans the construction of a combination canning and packing plant at San Benito, Tex. Estimated cost $75,000. Machinery and equipment including fruit marking machines, electric box machines, automatic packers, and other equipment will be required.

Candy Factory — Smith, Hinchman & Grylls, 800 Marquette Bldg., Detroit, Mich., Archts., are receiving bids for the construction of a 4 story candy factory on Duboise St. for Detroit Candy Co., 1528 Gratiot Ave., Detroit, Mich. Estimated cost $150,000.

Candy Factory—G. Haas & Sons, Phelan Bldg., San Francisco, Calif., awarded contract for a 3 story candy factory at 10th and Howard Sts. to Monson Bros., 251 Kearny St., San Francisco, Calif. Estimated cost $175,000.

Carbon Black Plant — General Atlas Chemical Co., Pampa, Tex., has been granted permit to construct a carbon black plant to consume 4,000,000 cu.ft. of residue gas daily from casinghead gasoline plants. Estimated cost $250,000. Private plans. Machinery and equipment will be required.

Cement Plant—Peerless Portland Cement Co., West Jefferson Ave., Detroit, Mich., awarded contract for the construction of six silos 50 ft. in diameter and 80 ft. high for storage of bulk cement on West Jefferson Ave. to MacDonald Engineering Co., 53 West Jackson Blvd., Chicago, Ill.

Chemical Plant—Grasselli Chemical Co., Guardian Bldg., Cleveland, O., had plans prepared for the construction of a 1 story, 80 x 140 ft. chemical factory. Estimated cost $50,000. C. D. Sperry, Guardian Bldg., Cleveland, O., is engineer.

Chemical Plant — Hackmuster Lind Chemical Co., McKees Rocks, Pa., awarded contract for a 3 story, 110 x 120 addition to chemical plant. E. H. Dobson, Birmingham Ave., Avalon, Pa. Estimated cost $50,000.

Coke Plant — Virginia Domestic Coke Corp., Richmond, Va., plans the construction of a plant for the manufacture of coke and its by-products to cost $2,000,000.

Compress Plant—Aransas Compress Co., J. K. Cain, Pres., Corpus Christi, Tex., is having plans prepared for the construction of a compress plant. Estimated cost $250,-000. Private plans. Electrically operated machinery and equipment will probably be required.

Compress Plant—Southern Compress Co., 511 47th St., Galveston, Tex., plans an addition to compress plant to double the capacity at 44th and 48th Sts. Estimated cost $75,000. New compress machinery and equipment will be required.

Compressed Gas Plant—California Compressed Gas Co., 2305 East 52nd St., Los Angeles, Calif., plans the construction of a compressed gas plant at Sacramento, Calif., initial capacity 1,000,000 cu.ft. per mo., ultimate total capacity 2,500,000. Estimated cost $100,000.

Compressed Gas Plants—Linde Air Products Co. subsidiary of Union Carbon & Carbide Co. Inc., 30 East 42nd St., New York, N. Y., is having plans prepared for the construction of compressed gas plants at Allentown, Pa., Grand Rapids, Mich., Tampa, Fla., Wichita, Kan. and Erie, Pa., will also receive bids about Oct. 15 for plants at Canton, O. and Casper, Wyo. Estimated cost $150,000 each. Private plans. Compressors, motors, etc. will be required.

Copper Leaching Plant—Davison Chemical Co., Garrett Bldg., Baltimore, Md., plans the construction of a copper leaching plant at Curtis Bay. Estimated cost $400,000.

Cotton Oil Mill — Plainview Cotton Oil Mill, c/o J. C. Jones, Mgr., Plainview, Tex., plans renovating cotton oil mill. Estimated cost $30,000. Private plans. Equipment including six linters, new type of cookers, etc., will be required.

Cotton Seed Products Plant—E. Schlaffke, et al., Electra, Tex., plans the construction of a cotton seed products plant. Private plans. Complete machinery and equipment will be required.

Creosoting Plant—Tennessee Creosoting Co., subsidiary of Cook Tie & Pole Co., Commercial Trust Bldg., Philadelphia, Pa., plans the construction of a creosoting plant. Estimated cost $100,000.

Dye Stuff Factory—Grasselli Dye Stuffs Corp., Grasselli, N. J., awarded contract for the construction of three 1 story dye stuff factories at Linden, N. J., to M. Byrnes Bldg. Co., 430 Westfield Ave., Elizabeth, N. J. Estimated cost $150,000.

Fertilizer Plant—New England Rendering Co., 4 Abattoir Grounds, Brighton, Mass., plans the construction of a fertilizer plant. Estimated cost $40,000. Architect not selected.

Gas Plants — International Combustion Engineering Co., 200 Madison Ave., New York, N. Y., will build low temperature carbonization gas plants at Piscatawaytown and Raritan, N. J. Estimated cost $1,500,000 and $50,000 respectively. Private plans. Works will be done by separate contracts.

Helium Production Plant—U. S. Dept. of Commerce, Helium Div., Bur. of Mines R. A. Cattell, Engr. in charge, Washington, D. C., is having plans prepared for the construction of a helium production plant. Estimated cost $500,000. Complete machinery and equipment will be required at Amarillo, Tex.

Laboratory—Delbert K. Perry, 17 Court St., New Britain, Conn., Archt., will receive bids until Oct. 25, for the construction of a 3 story laboratory at Storrs, Conn., for Connecticut Agricultural College. F. L. Salmon, Controller, Hartford, Conn. Estimated cost $354,000.

Laboratory (Chemical) Etc. — Canadian Westinghouse Co. Ltd., Sanford Ave., N., Hamilton, Ont., awarded contract for the construction of a chemical laboratory, brass foundry, core and melting building, etc., on Aberdeen Ave. to W. H. Yates Construction Co., 17 Main St. E., Hamilton, Ont. Estimated cost $175,000.

Laboratory (Chemistry)—Trinity College, R. B. Ogilby, Pres., Hartford, Conn., is having plans prepared for the construction of a chemistry laboratory. Estimated cost $350,000. Trowbridge & Livingston, 527 Fifth Ave., New York, N. Y., are architects. H. C. Greenley, 129 East 54th St., New York, N. Y., is associate architect.

Laboratories (Chemistry and Physics)—School Board, Bridgeburg, Ont., awarded contract for a 3 story, 150 x 180 ft. high school, including chemistry and physics laboratories, on Wintermute St. to Smith Bros., 1740 Ellen St., Niagara Falls, Ont. Estimated cost $122,600. Machinery and equipment will be purchased.

Laboratories (Chemistry and Geology, Physics and Biology)—University of California, Los Angeles, Calif., is having plans prepared for a group of buildings including chemistry and geology, physics and biology laboratories, etc. on Westwood Campus. Estimated cost $150,000. Allison & Allison, Hibernian Bldg., Los Angeles, Calif. and G. W. Kelham, Sharon Bldg., San Francisco, Calif., are architects.

Lacquer Factory—Egyptian Lacquer Mfg. Co., 1142 South Maple St., Los Angeles, Calif., awarded contract for a 1 story, 50 x 50 ft. addition to lacquer factory to Houghton & Anderson, 143 Rose St., Los Angeles, Calif.

Leather Factory — Wineapple Bros., Mason St., Salem, Mass., are having plans prepared for the construction of a 1 story, 60 x 80 ft. leather factory. W. H. Hunt & Son, 197 A. Washington St., Salem, Mass., are architects.

Packing Plant—Rio Grande Valley Citrus Growers Assn., Mercedes, Tex., awarded contract for the construction of a 1 story, 90 x 100 ft. citrus packing plant to American Rio Grande Land & Irrigation Co., Mercedes, Tex. Estimated cost $25,000.

Paint Factory—Advance Paint Co., 540 West Norwood St., Indianapolis, Ind., awarded contract for the construction of a 1 story paint factory to Edward Newall, 1315 Mills St., Indianapolis, Ind. Estimated cost $43,000.

Paint Factory—Boydell Bros. White Lead & Color Co 432 East Lafayette St., Detroit, Mich., plans the construction of a 1 and 2 story paint factory. Halpin & Jewell, 1024 Hammond Bldg., Detroit, Mich., are architects.

Paint Factory—H. B. Davis Co., H. B. Davis, Pres., Bayard and Severn Sts., Baltimore, Md., plans an addition to paint factory.

Paint Factory — International Paint Corp., G. B. Dunford, Gen. Mgr., 13th St. and Southern Ry., East St. Louis, Ill., will build a 2 story factory for the production of asphaltum, graphite, insulating, chassis, battery box and acid proof paints, fibre cement and roof coatings, reducing oils, etc., at Colgate Creek and Pennsylvania R.R., Baltimore, Md.

Paint Factory—Standard Plate Glass Co., First National Bank Bldg., Pittsburgh. Pa., awarded contract for the construction of a 4 story, 40 x 153 ft. paint factory on Galveston Ave. to The Construction Corp., 3216 Smallinger St. Estimated cost $150,000.

Paper Mill — Canadian International Paper Co., 355 Beaver Hall Sq., Montreal, Que., is having plans prepared for an addition to paper mill at Gatineau, Que. Estimated cost $600,000.

Paperboard Mill — Dominion Boxboards, Ltd., 130 Duchess St., Toronto, Ont. awarded contract for the construction of a paperboard mill including a 100 x 600 ft. beater and finish room, etc. to Toms Contracting Co., 245 St. Clair Ave. E., Toronto, Ont. Estimated cost $1,000,000.

Pasteurizing Equipment — Galveston Model Dairy Co., 706 23rd St., Galveston, Tex., plans to purchase pasteurizing machinery and equipment for proposed dairy. Estimated cost $45,000.

Pickle Factory — H. J. Heinz Co., 1062 Progress St. N. S., Pittsburg, Ont., is having plans prepared for the construction of addition to pickle factory at Leamington, Ont. Estimated cost $100,000. Private plans.

Porcelain Factory Equipment—Mogadore Insulator Co., Mogadore, O., is in the market for complete equipment including slip house equipment, land presses, two sagger machines, etc. for proposed 1 and 2 story, 100 x 200 ft. porcelain factory. Estimated cost $100,000.

Pottery Plant—Watt Pottery Co., Crooksville, O., awarded contract for the construction of a 2 story, 42 x 127 ft. pottery plant on China St. to Bonifant & Karr, Crooksville, O. Estimated cost $28,000.

Pottery Plant Addition—H. A. Weller Co., Zanesville, O., awarded contract for a 1 story, 200 x 250 ft. addition to pottery plant to The Austin Co., Union Trust Bldg., Pittsburgh, Pa. Estimated cost $35,000.

Powdered Milk Plant—C. H. Aroyan, c/o Point Reyes Creamery, Point Reyes, Calif., plans the construction of a powdered milk plant at 7th and Orange Sts. Estimated cost $40,000.

Pulp Mill — Union Bag & Paper Co., Woolworth Bldg., New York, N. Y., is having preliminary plans prepared for the construction of a pulp mill, 120 ton capacity at Tacoma, Wash. Estimated cost $2,200,-000. H. S. Ferguson, 200 5th Ave., New York, N. Y., is engineer. Machinery and equipment will be required.

Pulp and Paper Mill.—Northwest Ontario Development Co. Ltd., c/o B. R. Heplurn, Picton, Ont., plans the construction of a pulp and paper mill in Sioux Lookout district.

Pulp and Paper Mill—Sacramento Pulp & Paper Co., 404 Bryte Bldg., Sacramento, Calif., plans the construction of a pulp and paper mill, 25 ton daily capacity.

Rayon Plant — Du Pont Rayon Co., Buffalo, N. Y., c/o E. I. du Pont de Nemours & Co., Wilmington, Del., has acquired a 517 acre site and plans the construction of a plant for the manufacture of artificial silk. Estimated cost approximately $10,000,000. A. J. Saville, Richmond, Va., is engineer.

Refinery (Oil)—Empire Refineries, Inc., Bartlesville, Okla., plans extensions and improvements to oil refinery at Ponca, Okla. Estimated cost $1,000,000. Private plans.

Refinery (Oil)—Humble Oil & Refining Co., Houston, Tex., has made application to City Commission for permit to construct an oil refinery on Frio City Rd., San Antonio, Tex. Estimated cost $3,000,000. Private plans.

Refinery (Oil)—Mid-Kansas Oil & Gas Co., W. W. Fleming V. Pres., Findlay, O., plans the construction of an oil refinery at Del Rio, Tex. Estimated cost $200,000. Private plans.

Refinery (Oil) — Reese Allen Refinery, Big Spring, Tex., is having preliminary plans prepared for the construction of an oil refinery. Estimated cost $100,000.

Rubber Factory—Archer Strauss Rubber Co., Herbert St., Framingham, Mass., will soon award contract for the construction of a 1 and 2 story rubber plant. Estimated cost $100,000. I. Richmond, 248 Boylston St., Boston, Mass., is architect.

Rubber Factory — Canadian Goodrich Rubber Co., 521 King St. W., Kitchener, Ont., awarded contract for the construction of a 3 story, 100 x 132 ft. addition to rubber factory to Foundation Co. of Canada, 746 Sherbrooke St. W., Montreal, Que. Estimated cost $200,000.

Rubber Factory—Firestone Tire & Rubber Co., Hamilton, Ont., awarded contract for the construction of a rubber factory to Yates Construction Co., 17 Main St., Hamilton, Ont. Estimated cost $250,000.

Rubber Plant — General Tire & Rubber Co., 312 South Michigan Ave., Chicago, Ill., is having sketches made for the construction of a 4 story warehouse for rubber plant at Cottage Grove Ave. and 23rd St. Estimated cost $250,000. N. M. Dunning, 25 East Jackson Blvd., Chicago, Ill., is architect.

Rubber Factory — Holtite Mfg. Co., Warner and Ostend Sts., Baltimore, Md., will build a 1 story, 50 x 155 ft. addition to plant.

Rubber Factory—Mansfield Tire & Rubber Co., G. W. Stephens, Pres., Mansfield, O., is having plans prepared for the construction of a 3 story rubber factory. Estimated cost $100,000. Private plans.

Soap Factory—Palmolive Peet Soap Co., Sixth and Carlton Sts., Berkeley, Calif., awarded contract for the construction of a 3 story annex to soap factory to P. J. Walker Co., Sharon Bldg., San Francisco, Calif. Estimated cost $150,000.

Soap Factory—Scholler Bros., St. Catharines, Ont., manufacturers of chemical soaps, awarded contract for the construction of an 80 x 169 ft. factory on Queenston St. to T. F. Jones, 167 Church St., St. Catharines, Ont. Estimated cost $40,000. Equipment will be required.

Soap Factory and Glycerene Plant—J. S. Kirk & Co., 1232 West North Ave., Chicago, Ill., will soon award contract for an 8 story, 75 x 206 ft. soap factory and 4 story, 56 x 110 ft. glycerin plant. Estimated total cost $1,000,000. R. E. Pingrey & Co., 134 South La Salle St., Chicago, Ill., are architects.

Sulphite Pulp Mill—West Lumber & Pulp Co., Aberdeen, Wash., had plans prepared for a sulphite pulp mill, 100 ton capacity.

Sugar Refinery—Corn Products Refining Co., North Kansas City, Mo., is having plans prepared for the construction of a sugar refinery. Estimated cost $1,000,000. Private plans.

Torpedo Plant — Eastern Torpedo Co., c/o D. A. Koonz, Mgr., Odessa, Tex., plans the construction of a torpedo manufacturing plant. Estimated cost $75,000. Private plans.

Varnish Factory—Pontiac Varnish Co., Brush St., Pontiac, Mich., awarded contract for a 2 story varnish factory to Brasgalla Co., 9752 Cascade Ave. Estimated cost $50,000.